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Educational Broadcasting.

ALREADY we have heard much concerning the powerful influence which broadcasting must have upon what we now accept as civilisation. Its effect in helping to break down national and geographical barriers, and its consequent destruction of the suspicions, hatreds, meannesses, and intolerances which ignorance breeds among peoples living within narrow circles, cannot yet be fully estimated. That effect is a result of a broad and informal educational influence. It is an effect which is inevitable just because broadcasting cannot be other than an educational influence. If that be the case at present, it is clear that, when the possibilities of broadcasting as a formal and deliberately organised means of education are considered, there can be no doubt that an instrument of incalculable value will be shaped for the service of mankind

The British Broadcasting Corporation is to be congratulated upon the steps it has taken towards linking its activities with the educational system of Great Britain From its early days it has striven untiringly towards that end The history of those steps may be briefly described It began with a committee of inquiry into broadcasting and adult education under Sir Henry Hadow Then followed an interim committee to deal with that specific problem Finally, a central council for broadcast adult education was set up under Lord Justice Sankey. That council is composed of representatives of the most important national interests, and it is now completing admirable organisation which will use wireless in the great service of adult education Meanwhile, the famous Kent experiment in the use of wireless to broadcast to schools having been successfully completed, the B.B.C. has just set up a central council for school broadcasting under the chairmanship of the Right Hon. H. A L Fisher, which is composed of similar national interests to the council we have described above This council is proceeding to deal with the specific problem of broadcasting to schools.

The building of such excellent machinery cannot, of course, be productive of anything but good. If, then, at the very moment when we wholeheartedly welcome it, we also make one or two suggestions for its use, we feel sure that we shall be acquitted of any desire to make querulous and carping criticism at too early a stage. The B B.C. is, however, a very modern part of modern life, and we would be sorry if it missed the special opportunities it has of taking care that its educational

activities follow, and get the best out of, the changes which are taking place in the structure of our civilisation That does not mean that it should wholly ignore tradition or indulge in a crude stamping upon our special—almost sanctified—academic traditions It means the frank recognition of new values which the changes we have mentioned are presenting us

For our present purposes we have in mind the work of adult education rather than the work of our primary and secondary schools, and we direct attention to what we have called new values because, in a paper on the relation of broadcasting to further education, read recently to the Association of Technical Institutions, we see a tendency to make the old distinction between what is called cultural and what is called vocational education "I have often wished," said Mr. Siepmann, the author of the paper, "that it were possible to introduce into the technical colleges more subjects representative of the cultural *as opposed to* vocational interests" (our italics). Later he suggested that by "correlating cultural and vocational aims, and by the establishment of a broader basis of instruction, and an attempt to give to the life and work of your institutes a social as well as academic significance," a recruitment of disinterested students would take place Finally, he is "inclined to think that the technical subject [for the purpose of a broadcast talk] is less appropriate than the cultural," and suggested that, while the B B C will go carefully and sympathetically into the matter, there is no "immediate possibility of the extensive adaptation of our programmes to your needs"

If Mr. Siepmann thinks that those needs include broadcast talks on engineering or chemistry or building, we are sure he does not yet understand the tone and spirit of the modern technical institution If he thinks that the curriculum of the same institution does not include subjects which he himself would regard as "cultural as opposed to vocational," he is very much mistaken His errors are, however, common ones and arise out of the words 'technical education' Much misunderstanding might be removed if Lord Eustace Percy's phrase 'education for industry and commerce' were used. It is a term which may be neither entirely satisfactory nor descriptive, but it would help to do away with much of the false distinction between cultural and vocational education—the new phrase under which the ancient and arid controversies over, and distinctions between, science and art, tends to be revived.

If education is to help in the solution of our problems, we must realise that to treat academic matters apart from social and industrial matters is to fail in all of them. What are usually known as academic or cultural subjects are only a part of education In themselves they cannot support life as we know it The spiritual values on which we set so great a store are dependent on what are, at first sight, merely material things But the two cannot be separated Education for industry and commerce can be, and is, used to make men and women realise social relationships. Through the grouped course methods of technical institutions, students are shown how one subject is akin to others, how it has value not merely in its own utilitarian content, but also in kinship with others which are at first apparently independent and unconnected

The process is producing a culture which is wider and nobler than our older notions, a culture which is neither lonely nor snobbish, a culture which does not stop short at pleasant abstractions, but is forging a link between the many sides of our world and humanising industry no less than making it efficient Those who know technical institutions know that they are places where is taught not only the art of earning a living, but also the sacred art of living itself

We hope, then, that the B B C.'s new educational machinery will not hold too fast to all the parts of academic tradition, that it will realise the vital need for education to march with our changing conditions, that it will be thorough in its examination of phrases like 'cultural and vocational and technical subjects', and that it will regard the changes to which we have referred not as tending to a blind and formless industrialism, but as the outward forms of the newer values which science has made available for us

A Criminal Tribe of India.

The Land Pirates of India an Account of the Kuravers, a Remarkable Tribe of Hereditary Criminals, their Extraordinary Skill as Thieves, Cattle-lifters and Highwaymen, etc, and their Manners and Customs By W J. Hatch Pp. 272+16 plates (London Seeley, Service and Co, Ltd, 1928) 21*s* net

INDIAN ethnology has been a favourite exercising ground for theorists Recent political developments have done much to encourage them along certain lines Starting from above and adopting the view of a dominant social order, they have

tended to neglect the light to be thrown upon cultural history by direct observation of the more primitive races It is to the credit of the late Sir Herbert Risley, the late Mr. William Crooke, and Mr Edgar Thurston, to name some of the principal workers only, that they saw the study of India as a whole and each in his own special province linked up the investigation of primitive and advanced on a basis of observed fact regardless of political or social theory The result is to be seen in Mr Crooke's conclusions as to the relations of the Hindu pantheon and local godlings, and in Mr. Thurston's treatment of the out-caste and criminal and primitive tribes in the *Madras Gazetteer*

It is inevitable that such reflections should arise on reading Mr Hatch's book on the Kuravers, the tribe whose thieving proclivities have endowed them with the name of 'Land Pirates' It is more than seventy years since officers of the Government whose duties were to prevent dacoity and *Thuggee* first made any study of their peculiarities Yet beyond the notes of police manuals and the accounts in the *Madras Gazetteer*, practically no attempt has been made to give any account of them commensurate with their interest, and this notwithstanding the fact that these nomad thieves are scattered all over the Madras Presidency, as well as in the Canarese Nadu and the Bombay Presidency, and in the Madras Presidency alone number just under two hundred and twenty-one thousand The number in the Bombay Presidency also is said to be considerable

The Kuravers are systematic thieves by descent, by habit, and by proclivity. They work only when they are not able to steal. They wander from village to village but may often earn a lucrative living by a species of blackmail, protecting the villagers from the predatory visits of their fellow tribesmen for a payment Yet the Kuraver, unlike other criminal tribes, as a rule will not kill in order to rob Many of them practise palmistry, the term for which in Tamil is said to be the derivation of their name

It is always interesting, but seldom easy, to trace the origin of a tribe or caste in India General Hervey, the great authority in the middle of the last century on Indian crime, says the tribe migrated from the south, but one version of their origin makes them the descendants of Prince Dharmaraja by a fortune-teller (*Kuru*), which would point to a northern descent Their language, however, is Dravidian. Physically they are not a low type, and do not differ materially from the other castes of Southern India One story adopted by the Kuravers themselves points to their having at one time lived as hunters and having been driven out by pressure of population Mr Hatch is no doubt right in rejecting the view that they were originally servants of the temples of Southern India, who were supplanted by the arrival of a higher grade of priests

The Kuravers are split up into a large number of divisions, normally each hamlet or settlement containing members of one family only. From early times they were distinguished as nomad and settled. Four main divisions fall into a number of subdivisions, but there are also other classifications, generally based upon occupation, although this is not necessarily the occupation followed to-day. Such are the salt merchants, those who split bamboo for the making of baskets, snake charmers, and so on All these ostensible occupations disguise the real occupation of the members of the tribe, which is thieving.

The Kuravers worship a number of deities These are, of course, especially propitiated to attain success in thieving expeditions The temple of Subramania at Palni is much frequented by pilgrims Another shrine of great sanctity is that at Chidambaram in South Arcot Magic and superstitious practices loom large in their lives Mr Hatch describes a remarkable belief that a man who has been killed by magic may be resuscitated—a dangerous practice, but one which may prove of great utility, as the nerves extracted from the dead man's legs are most efficacious in the practice of further magic against an enemy

Mr. Hatch has had a long experience of the people of whom he writes; but although he describes the tribe and its life very fully and informatively in certain respects, a more systematic account would have been valued In the case of marriage, for example, it is desirable to know what, beyond the bride payment, is the basis of arrangement Marriages are sometimes determined even before the birth of the children, and it is said that a man may claim his sister's two eldest daughters in this way. Within what degrees are marriages forbidden or prescribed? It is also desirable that the position of women should be more precisely defined. Mr. Hatch implies that their prominence and importance in the Kuraver social system is due in part to the fact that their husbands spend so much time in prison, in part to their utility and their skill in the less important branches of the tribal profession. More information upon this and related matters would have been welcome and would have increased the value of this study of a remarkable people

Alchemical Manuscripts.

(1) *Union Académique Internationale. Catalogue des manuscrits alchimiques grecs* Publié sous la direction de J Bidez, F Cumont, A. Delatte, O. Lagercrantz et J. Ruska Tome 5 i. *Les Manuscrits d'Espagne*, décrits par Prof C O Zuretti, ii *Les Manuscrits d'Athènes*, décrits par A. Severyns. Pp v + 174. (Bruxelles Maurice Lamertin, 1928.) 10 Belgas.

(2) *Union Académique Internationale. Catalogue of Latin and Vernacular Alchemical Manuscripts in Great Britain and Ireland dating from before the XVI Century* By Dorothea Waley Singer, assisted by Annie Anderson Vol. 1 Pp. xxiii + 326. (Brussels Maurice Lamertin, 1928) n p.

(3) *Union Académique Internationale Catalogue des manuscrits alchimiques grecs* Publié sous la direction de J. Bidez, F Cumont, A Delatte, O Lagercrantz et J Ruska. Tome 6 *Michael Psellus, Épître sur la Chrysopée ; Opuscules et extraits sur l'alchimie, la météorologie et la démonologie*, publiés par Joseph Bidez; en Appendice, *Proclus, Sur l'art hiératique*, *Psellus, Choix de dissertations inédites*. Pp. xiv + 246. (Bruxelles · Maurice Lamertin, 1928) 15 Belgas.

THE history of alchemy has a twofold claim on our attention In the first place, it still has its adherents, who are found not merely in the Orient but also in America, Germany, France, and England itself It was recently related that the philosopher's stone had been prepared at Los Angeles by a woman alchemist, who thus takes rank with Mary the Copt and Cleopatra, while M. Jollivet Castelot from time to time issues reports of his successful transmutations That this art should flourish even in the twentieth century is a striking witness to human credulity, and as such may engage the notice of psychologists

Secondly, alchemy is the direct ancestor of chemistry, and in view of the modern trend in the philosophy of science, the importance of a study of origins need not be emphasised here. Although there are dissentients, it is commonly believed that chemistry arose in the early years of the Christian era, as a result of the fusion of Egyptian metallurgical and other arts with the mystical philosophies of the Neo-Platonists and Gnostics Unluckily, the Neo-Platonists regarded matter as the principle of unreality or evil, from which the disciple should attempt to detach himself, while the Gnostics cared little for the phenomena of the sensible world, being much more anxious to attain to a knowledge of the invisible cosmos It is significant for the later history of the science that one of the earliest chemical writers, Zosimos the Panopolitan, was a Gnostic, while the Neo-Platonic conceptions of sympathetic action, action at a distance, the distinction between occult and manifest properties, the influence of the stars, and the mystical powers of numbers, all permeate chemistry from its beginnings at the time of Plotinus until the close of the seventeenth century It would, indeed, scarcely be going too far to say that some of these ideas are with us still nitrogen is manifestly inert but occultly active, and the structure of the atom is ultimately a matter of the relations between numbers, as Prof Dingle has observed.

To get a clear picture of the development of chemical thought throughout the ages, a great deal of work remains to be done Even the comparatively recent eighteenth century has been insufficiently studied, and the farther we go back the more hazy does our knowledge become The first step to rectify this unsatisfactory state of affairs is obviously an investigation and classification of the material at our disposal The ancient literature of alchemy was incredibly large, and the number of manuscripts which have survived is by no means insignificant. The careful cataloguing of these manuscripts has been undertaken by competent scholars under the patronage of the Union Académique Internationale, and the three volumes now under review represent a valuable continuation of the programme of work

(1) The fifth volume of the "Catalogue des manuscrits alchimiques grecs" deals with the manuscripts of Spain, described by C O. Zuretti, and those of Athens, described by A. Severyns. Certain of the Spanish manuscripts furnish useful data for the study of the relations between the principal Greek alchemical works, while others enrich our knowledge of the "Koeranides" The Athenian manuscripts are but five in number, and four of these date only from the eighteenth or nineteenth centuries, the other being of the fourteenth The modern ones are of value as probably representing more ancient works which have to-day disappeared or lie hidden in obscure libraries.

(2) Of more general interest is the first volume of Mrs Singer's great catalogue of Latin and vernacular alchemical manuscripts in Great Britain and Ireland, dating from before the sixteenth century. Mrs Singer's enormous collection of bibliographical data is of course very well known to all historians of science, few of whom are not indebted to her

for information always promptly and generously given It is therefore with a gratitude partaking of a hope for future favours that we congratulate Mrs Singer on the appearance of her catalogue and the British Academy on its liberality in bearing the cost of printing it

In an excellent little introduction, Mrs. Singer explains the direct Greek influence on Latin alchemy "The iconoclastic disputes in the Byzantine Empire led to the dispersal of artificers, who carried their workshop recipes with them westward In the work of the eleventh century chronicler, Adam of Bremen, we read of a converted Jew named Paul who, after having visited Byzantium, came to Bremen bringing with him the art of transmuting copper into gold." Several alchemical or rather technological manuscripts of evident Greek ancestry are described in the catalogue, and practical chemistry of a primitive nature was clearly practised in Europe before the great influx of chemical knowledge from Islam in the twelfth and thirteenth centuries This influx is manifested by the appearance of Arabic names, technical terms, and forms of expression, and in several cases we are in possession of the original Arabic texts of Latin alchemical works Mrs Singer's catalogue will doubtless help us to find other such cases, for several of her titles are strongly reminiscent of Arabic alchemical books We notice, for example, a treatise by 'Mirer,' whom we should guess to be Mahararis, a Muslim alchemist about whom little is known but of whom some writings are extant, and a 'filius Hahmil,' who is undoubtedly Ibn Amyal, as the *incipit* of the manuscript agrees with the opening sentence of an Arabic work by him These are but foretastes. Mrs Singer's catalogue is as full of good things as a Christmas pudding and will require even more digestion We may perhaps direct special attention to the large number of manuscripts in English

(3) Volume VI of the Greek catalogue is devoted to a study of Michael Psellus's "Letter on Goldmaking," by Joseph Bidez, with appendices on certain unedited dissertations of the same writer and a tract of Proclus "On the hieratic art" Psellus, who was professor at the Academy at Constantinople about the middle of the eleventh century, expressed very enlightened views upon the study of Nature. Contemporary indifference to natural phenomena aroused his indignation as only too likely to perpetuate or re-awaken ancient superstitions. He believed in the possibility of the transmutation of the metals, but denied that a knowledge of alchemy was a secret confined to the initiated. The operation of the alchemist, he considered, finds its explanation in the Aristotelian theory of the four elements, from which everything comes by combination and into which everything is resolved by dissolution. Nothing, he says, is produced without cause belief in prodigies is merely a result of our lack of comprehension of the causes of phenomena It is not without interest, in view of the fact that at this time Arabic works were being translated into Greek, that Avicenna had expressed an almost identical opinion in 1022, when he wrote (concerning a 'natural wonder'), "These things appear strange only on account of their infrequent occurrence," the wonder vanishing when the causes are known

One thing emerges very distinctly from the study of ancient scientific treatises It is that scientific genius and scientific method are not entirely the monopoly of post-Galilean days, but that the great advance which science has made during the last three hundred years is due in no small degree to better co-ordination and transmission of ideas by a much greater number of workers, rather than to any sudden efflorescence of scientific ability

E J. Holmyard

A Hunter-Naturalist's Memories.

Retrospect: Reminiscences and Impressions of a Hunter-Naturalist in Three Continents, 1851–1928 By Abel Chapman. Pp. xix + 353 + 56 plates. (London and Edinburgh. Gurney and Jackson, 1928) 25*s*. net

Mr. Abel Chapman's "Retrospect" is a fascinating volume, richly illustrated from his own drawings and with coloured plates of singular beauty from those of the late Mr Joseph Crawshall While most of the chapters will appeal chiefly to sportsmen, the author, as a trained and vigilant observer of animal behaviour in many lands, provides just the kind of observation usefully to complement work in the laboratory and the museum He is puzzled by the enigma how animal and vegetable life can persist in waterless, rainless, dewless African deserts.

"In the Sudan we have two closely related forms of the hartebeest group, namely, the Tiang (*Damatescus tiang*) and the Korrigum (*D korrigum*), animals so nearly alike that a casual observer would scarce differentiate between them, yet, as regards thirst, as wide apart as the poles in their habits The tiang is a thoroughly bibulous beast. It inhabits the Steppe regions bordering on the White Nile, and is specially careful to resort twice a day to that river . . . and enjoy two long drinks; . the korrigum elects to reside permanently in

the waterless deserts of Kordofan, hundreds of miles from the Nile, and where never a drop of pure water can moisten his torrid throat and tongue year in and year out It is a contrast that passes understanding" (pp 144-5)

Finding it equally perplexing to comprehend how the plants on which the korrigum feeds can exist without water, Mr Chapman put the case before the late Sir Isaac Bayley Balfour, and gives the following extract from his reply

"Plants growing in waterless deserts are variously attuned to their environment Some may store water to tide them over long periods of drought Others, such as the mimosas which you indicate, are able to hold such water as they may obtain in the wood-tissues which they form, and also obtain a certain amount from the atmosphere The roots of these plants spread for long distances, and their rootlets attach themselves very firmly to the particles of sand in the soil. There may be no *free water* in the soil, and yet an adequate amount of what we call 'hygroscopic water' in the particles, and from these particles the root-hairs of plants may get their supplies."

Mr Chapman differs emphatically with those who entertain what he describes as "the Doctrine of Colour Protection," regarding it as "based upon the supposition or superstition that the Almighty had so camouflaged His creatures as to render the harmless invisible to their enemies, while the enemies themselves were equally aided in their predatory avocation by an obliterative coloration" (p 118) This is scarcely a fair summary of the conclusion at which many observers have arrived, which, indeed, is confirmed by Mr. Chapman as an experienced field-naturalist, for he admits that many animals assimilate so closely in colour to their environment as to be "virtually invisible to the human eye" (p 122), but as they are easily detected when they move, he objects to their colouring being pronounced protective

No one can have given much attention to birds without recognising in how many species colour serves the male for display and the female for concealment during incubation. This is almost universal in the duck tribe, although the Sheldrake, *Tadorna cornuta*, presents a significant exception, the female being well-nigh as brilliantly garbed as her mate, wherefore hereditary prudence causes her to incubate subterraneously in rabbit burrows

Among fishes also, the remarkable result of Dr Francis Ward's observation from his subaqueous chamber was to reveal how faithfully the glittering sides of certain fishes reflect surrounding water-weeds, stones, etc., with protective effect Mr. Chapman's long experience in various climes enables him to show that in very many wild animals their colouring is the reverse of protective; but it is unphilosophic to describe as "poetic theorists" (p 133) those who recognise a protective result from the colouring of certain other animals

It is a feature of these reminiscences that while in one chapter the author expresses vigorous dissent from the opinions formed by other naturalists, in another chapter he approves of action founded on those opinions Thus, while he denounces the enactment of a close time for water fowl in Britain as one of the "long-drawn bungles of those in high places at the instance of hysterical protectionists" (p 42), he applauds enthusiastically similar legislation which has saved the Spanish ibex, *Capra hispanica*, from extermination (p 99)

A discussion on the maximum speed of flight attained by different kinds of bird is an interesting essay contribution on a difficult problem which Mr Chapman does not claim to have solved; but suggests that, whereas Flight-Lieut Webster in the international aeroplane trials at the Lido in September 1927 registered a speed of 289 miles an hour, the speed of bird-flight has hitherto been greatly under-estimated (Chap XIV)

Since this notice was written, the reviewer has learnt with sincere regret that the author is no more—regret that must be shared by all who esteemed Mr. Chapman as an experienced naturalist, a skilful draughtsman, and an entertaining writer.

HERBERT MAXWELL

Photographic Star Fields.

Isaac Roberts' Atlas of 52 Regions. a Guide to Herschel's Fields (avec texte anglais et texte français). Edition commemorating Isaac Roberts' Centenary (1829–1904) By Mrs Isaac Roberts (*née* Dorothea Klumpke) Pp 44 + 61 plates (London Wheldon and Wesley, Ltd, n d) 42*s* net

IN the *Philosophical Transactions*, 1811, Herschel gave a list of fifty-two regions in the sky which he described as showing "extensive diffuse nebulosity" Little attention would appear to have been given to the matter at the time, and it was not until 1862, when Auwers reprinted the list, that we find further mention of the fields in question. Thirty years later, Barnard reprinted the list in *Knowledge*, but again no observations are recorded

It was to determine the presence and extent of the nebulosity observed by Herschel that, in 1903,

Isaac Roberts undertook a systematic examination of the fifty-two fields Roberts photographed each field simultaneously with his 20-inch reflector and with a 5-inch Cooke lens The result of this survey was given in a paper which appeared in the *Monthly Notices*, *R A.S* , vol. 63 In this, Isaac Roberts reported that in four of the regions only had his photographs confirmed Herschel's observations. In the other forty-eight regions no trace of nebulosity was shown on his plates In recording this he was reporting the result of a survey taken on a definitely determined plan laid down beforehand The exposure time given to both series of photographs was ninety minutes, this being considered sufficient to show any nebulosity likely to have been seen by Herschel It was pointed out at the time that both Max Wolf and Barnard had photographed nebulosities in some of these forty-eight areas There the matter rested for a while, until, in 1926–27, Father Hagen published the results of his visual survey, in which he confirmed Herschel's observations

As a tribute to the memory of her husband, Mrs Isaac Roberts now publishes an atlas of the fifty-two regions, consisting of sixty plates, reproduced from the original negatives taken by him in the course of his survey The atlas is remarkable for the care which has evidently been taken to ensure a faithful copy of the original plates As photomechanical reproductions of astronomical photographs they are amongst the finest we have seen The atlas, as a whole, is very tastefully got up, and it is an easy matter to make identifications on the plates, full particulars being given on each sheet The plates are reproductions in ' negative,' the stars appearing as dots on a white ground , undoubtedly the best way of reproduction To those interested, this atlas should prove to be one of the greatest value The plates have been reproduced on an enlarged scale of 10 mm =6 3′ for reflector plates and 10 mm =32′ in the case of the 5-inch lens photographs.

The text which accompanies the atlas contains a short account of Herschel's observations of the fields, followed by Isaac Roberts' report on the result of his photographic survey. A very full and complete description of the charts, accompanied by tables, is also given There is also a chart showing the distribution of the fifty-two areas, which are somewhat scattered over the northern hemisphere and extend to 100° N.P D In a preface, Father Hagen, Director of the Vatican Observatory, gives a historical account of the observations of these regions of the sky hitherto made

In publishing this series of plates, Mrs. Isaac Roberts could not have chosen a more fitting manner of paying tribute to the memory of one who was a pioneer in astronomical photography, and whose work in this direction gained for him the well-merited reward of the gold medal of the Royal Astronomical Society The plates now reproduced are further evidence of the skill and devotion with which he applied himself to his task.

No doubt many will be glad to know that copies of the atlas may be purchased

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Our Bookshelf.

Ice Cream a Textbook for Student and Manufacturer By Prof G D Turnbow and L A. Raffetto Pp. ix+407. (New York. John Wiley and Sons, Inc , London: Chapman and Hall, Ltd , 1928) 20*s* net

The making of ice cream has become an important branch of the dairy industry in the United States, and the above volume has been written to serve as a text-book for students—instruction in ice cream manufacture is now given in thirty of the State colleges in America—and a reference book for those engaged in the trade

The material in the book is well arranged. First a historical introduction, then, after a discussion of the food value of ice cream, three chapters are given to recipes used in making the many different kinds of ice cream which are mentioned, some of them of an elaborate nature The use of fresh fruit and fruit juices plays an important part in these recipes In another chapter the basic materials of ice cream—milk, cream, butter, sugar, gelatine, and eggs—are dealt with, and a number of formulæ by which the proportions of the ingredients for any mixture may be calculated are given. Mixing is followed by pasteurisation and after this operation the mixture is homogenised, to break up the fat globules and increase the dispersion of the fat, then comes the freezing of the mixture Complicated machinery is required for the last two operations, and a good account of it is furnished. An important chapter is the one dealing with the various engineering questions connected with the running of a modern ice cream plant As dairy products are the main raw material, methods for their analysis are given, as are also methods of bacterial analysis

Although the manufacture of ice cream in Great Britain in no way approximates to the industry in the United States, there are no doubt many to whom this book will appeal, and to them it can be strongly recommended Perhaps in time—and a start has already been made—ice cream will become as popular in England as in America; it is clear that an increase in consumption will be to the benefit of the dairy industry. Already there is a demand on a small scale for instruction in ice-cream making, and two at least of our dairy institutes have taken up the subject

Dielectric Phenomena 2: *Electrical Discharges in Liquids*. By S. Whitehead Edited with a Preface by E. B Wedmore (Published for the British Electrical and Allied Industries Research Association, being Reference L/T 30.) Pp. 137 (London . Ernest Benn, Ltd , 1928) 12*s* 6*d* net.

IN the first volume of this treatise, Mr. Whitehead discussed electrical discharges in gases So long ago as 1905, A. Russell pointed out (*Proc. Phys. Soc.*, vol 20, p 49) that the maximum stress at which a spark ensued between spherical electrodes immersed in a gas was constant within certain limits In 1910 the same physicist pointed out (*idem*, vol 23, p. 86) that an algebraical expression of the form $A + B/\sqrt{a}$, where A and B are constants and a is the radius of either of two cylindrical electrodes, could be used to predict the stress at which ionisation begins in air

Since then, an immense amount of research to discover new laws and to show how the results could be applied to testing commercial materials has been done. When the electrodes are in a liquid and the voltage is raised sufficiently, an unstable rise in the small conduction current takes place at a definite voltage This may discharge the electrodes or may result in the formation of an arc This phenomenon the author terms 'sparkover in liquids.' Previous to its occurrence, transient flashes sometimes pass between the electrodes, or streamers may spread out into the gap In rare cases a glow may be observed previous to the sparkover, somewhat similar to the corona we see in air In most cases the electric strength of a liquid depends on the impurities in the liquid, and hence a distinction has to be made between the electric strength of the pure liquid and the liquid in the commercial state The author states that theories put forward to explain the variation in the electric strength of liquids generally discuss merely the behaviour of the impurities. It appears that to get formulæ for the electric strength in these cases both the effective and the maximum potential difference have to be taken into account.

Organic Syntheses an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. Roger Adams, Editor-in-Chief Vol. 8 Pp vii + 141. (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1928.) 10*s* net

THE editors direct attention to two distinct processes for making both β-chloropropionic acid (from acrolein or trimethylene chlorohydrin) and trimethylacetic acid (from *tert* -butyl chloride or pinacolone) One of the most interesting of the preparations included in the volume is that of *l*-arabinose from mesquite gum This material, which is collected by the natives in the south-western United States and northern Mexico, is stated to furnish from 36 to 46 per cent of its weight of crude *l*-arabinose, and a yield of 25 4 per cent of the purified sugar is mentioned in the preparation described The raw material is said to be abundant, the process is simple, and the yields are comparatively high. A detailed description of Prof Roger Adams's apparatus for the catalytic hydrogenation of organic compounds is another feature of this volume which merits particular mention, for a working account of a really dependable apparatus of this type has long been needed Prof Adams's hydrogenator is simple in construction, and the reviewer gladly avails himself of this opportunity of testifying to its effective working in actual laboratory practice J R

Fluorescenz und Phosphorescenz im Lichte der neueren Atomtheorie Von Peter Pringsheim (Struktur der Materie in Einzeldarstellungen, herausgegeben von M. Born und J Franck, Band 6) Dritte Auflage. Pp vii + 357 (Berlin. Julius Springer, 1928.) 24 gold marks

THE first edition of Prof Pringsheim's book appeared in 1921, and it consisted of just over two hundred pages The preface to the third edition is dated Christmas 1927, and this edition consists of more than three hundred and fifty pages Yet it is clear that the author must have used considerable restraint in order to keep the new edition within these bounds, when we remember the large amount of important work which has been published during the interval between 1921 and 1927. For example, we have the important work of Cario and his collaborators on the phenomena produced by collisions of the second kind, and researches, such as those of Wood and Ellett, on the polarisation of resonance radiation

Prof Pringsheim carefully describes all these new advances, and his book is a very useful guide to the whole subject of fluorescence and phosphorescence The subject is a very large one, which is continually growing at a rapid rate, and it is interesting to remember that the recent work on the newly discovered Raman effect must already have provided sufficient material to encourage Prof Pringsheim to look forward to the appearance of a fourth edition of his book.

Manuel de photographie Par H Vial (Bibliothèque professionnelle) Pp. viii + 276 (Paris J.-B. Baillière et fils, 1928) 16 francs

THE pages are not very large, nor are they exceedingly numerous, but M Vial has justified the title of "Manual of Photography" by giving the essence of each subject described, and avoiding such matter as belongs more properly to trade lists and circulars. The treatment is quite modern, including desensitising, sensitometry, enlarging, bromoil, ozobrome, photography of coloured objects, photography in colours (autochrome), and stereoscopic work. The subject is divided into four parts . (1) General and introductory, including elementary optics, objectives, perspective, and apparatus , (2) the negative , (3) the print; and (4) sundry matters mentioned above, and the use of artificial light. The illustrations are all helpful and nearly all are original, and the practical directions are sufficient in the more important sections.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

The Cameroon Gorilla.

IN NATURE of Dec 24, 1927, Sir Arthur Keith discussed a collection of gorilla skulls which I made in the Mamfe district of the Cameroon. German authorities had long separated this western race from the better-known Congo gorilla and had given the Cameroon gorilla the title of *Gorilla gorilla diehli* Yet no skin of this new species has yet been described, and so great an authority as the director of the Berlin Zoological Museum has even doubted if the species still exists

Two skins have recently come into my possession from the heart of the Mamfe area, one of which is a mature female, while the other is alleged to be her offspring and is a female of two or three years In each case the skull was tied to the skin

The coat of the infant is entirely black except for a patch of brown hair between the ears stretching five inches back from the forehead There are, however, a few sparse white hairs on the back, but not enough to render it in any sense grey It differs from the chimpanzee of the same age in this neighbourhood, in that the hair is shorter and coarser. The older female, which is probably the mother, has a coat which is quite black on the flanks and belly, but quite grey on the back except for a patch of brown six inches long above the forehead

The hirsute appearance is, therefore, in no respect different from the gorilla of the Ubangie district of the Congo, several fresh specimens of which I was privileged to see last year in Major Powell Cotton's magnificent collection. Nor is there any single feature of the skull which is peculiar to this new species

It is, therefore, open to question whether it is proper to erect a new species or even subspecies on such slender grounds, since such differences as can be shown to exist may well be racial

The really striking differences between the Cameroon gorilla and his fellow at the eastern extremity of the gorilla belt are those of habit and behaviour For whereas Carl Akeley and others have described the eastern gorilla as timid and retiring, the Mamfe gorilla is excessively ferocious and neither timid nor shy Alone among wild animals with which I am acquainted, the adult male gorilla will *always* attack man on sight This profound alteration in his behaviour as he approaches the western limits of his range might perhaps justify the creation of a new subspecies which could not be justified on anatomical grounds alone

Akeley's gorilla differed in another important respect from his western prototype, in that he always slept with his female belongings in trees. So far as I am aware, and I have slept among them several times, and as lately as last week, this is never the case with the Cameroon gorilla, among whom the great male will invariably make his bed on the ground at the base of the tree in full view of his females and offspring in their tree beds

This observation of mine has been held to be original and scarcely authentic, but on reference to the literature on the subject I find that H. von Koppenfels more than fifty years ago made the same observation in reference to gorilla inhabiting the country that lies between the mouth of the Muni River and that of the Congo.

The point I am anxious to emphasise is this · that if wide differences in habits and behaviour can give grounds for the creation of a separate species, then the Cameroon gorilla may fairly claim that distinction. If, however, a new species must show some definite and constant physical variation either in the bones or the hirsute appearance, it is impossible to separate the most easterly gorilla, that from Kivu, from those I have studied in the extreme west in the Cameroon and Nigeria Such differences as exist are racial and not specific N A DYCE SHARP.

Ogoja, Nigeria,
Jan 21.

Line Absorption Spectra in Solids at Low Temperatures in the Visible and Ultra-violet Regions of the Spectrum.

FROM extrapolation of X-ray data, it is known that the electrons in the N_1 (and N_2) shell of the ions of the rare earths possess *less* energy than those in the 0 shells Expressed in terms of the Bohr-Stoner scheme, the electrons in the 4_4 shell are held less tightly than those of the 5_1 or 5_2, etc , shells. According to that scheme the electrons are arranged in the following manner

Atomic Number of the Neutral Atom	Symbol of Ion	$1_1 \longleftrightarrow 4_3$	4_4	5_1
57	La^{+++}	closed shells	0	2
58	Ce^{+++}		1	
59	Pr^{+++}		2	
71	Lu^{+++}		14	

The proof that the 4_4 shell is gradually filled in this way was completely established by Hund (*Zeit fur Physik*, **33**, p. 855, 1926) By assuming the above arrangement and the presence of *normal* multiplet coupling between the orbital and spin moments of the electrons, he calculated the character of the most stable energy level for each ion and its corresponding magnetic moment just as if the ion were in the gaseous state. His results were in beautiful accord with the magnetic data on the solids and on their solutions—with but two exceptions

Similar calculations for the ions of the iron group failed of agreement as might have been expected, since chromic ion, for example, in solution, is the molecular ion $Cr(H_2O)_6^{+++}$ due to the water of *co-ordination* and not the atomic ion Cr^{+++} (*Jour Amer. Chem Soc* , **49,** p 2456 , 1927)

Such extraordinary immunity from external coupling as is exhibited by the ions of the rare earths in their magnetic behaviour suggested that their absorption spectra might resemble the line spectra of ions in the gaseous state The basic electronic level in each case would be, then, the one confirmed by Hund from its magnetic moment.

X-ray data lead to the conclusion that the energy necessary to remove a 4_4 electron completely from its ion is probably within the range of a quartz spectrograph Indeed, most of the salts are coloured, so that the energies required for electronic activation may be measured through glass We used a large quartz spectrograph from Hilger and a three-prism ' Uviol ' glass spectrograph from Steinheil

Of previous investigations which concern us here, those of Becquerel alone in 1906, in collaboration with Kamerlingh Onnes in 1908, and finally with Kamerlingh Onnes and de Haas in 1925, are the most important. (See the remarkable summary by J Becquerel in "Gedenkboek aan H. Kamerlingh Onnes," 1922, p. 288.) They studied the absorption spectra of minerals principally, which contained mixtures of rare earth salts, and found that upon lowering the temperature the narrow bands appearing at room temperature

became much narrower, and in some instances attained a sharpness comparable with the line spectra of gases. However, they made no recorded attempt to identify their spectra or to evaluate them. Their measurements were limited on the short wave-length side of the spectrum by the glass (Dewar tubes) which enclosed their crystals.

We have begun a systematic study of the absorption spectra of the individual rare earths from room temperature to that of liquid hydrogen, both in the visible and in the ultra-violet. At present we wish to report the general features of the spectra already obtained, those of gadolinium, samarium, and erbium.

GADOLINIUM.—The uniaxial crystal of $GdCl_3 \cdot 6H_2O$ was made from $Gd_2(SO_4)_3 \cdot 8H_2O$ of atomic weight purity prepared under the direction of Prof. B. S. Hopkins of the University of Illinois, to whom we are extremely grateful. The spectra were practically identical with that obtained from a crystal from another source. The spectrum consisted of about sixty lines similar in sharpness even at room temperature to the emission lines of iron which were used for comparison. At room temperature the entire spectrum was in the ultra-violet extending to about 2350 A. Upon lowering the temperature new faint lines appeared in the visible, and most of the old lines shifted slightly toward the red. There was but little change in the spectrum between the temperature of liquid air and that of liquid hydrogen.

The substitution of bromide for chloride did not affect the general appearance of the spectrum, but it separated the components of the multiplets a little, displacing some components toward the short and some toward the long wave-lengths.

From the magnetic moment of gadolinium ion we know that the level lowest in energy is an ^8S term, and by the Hund theory the other basic levels belong to systems of lower and even multiplicity. Groups of lines allow themselves easily to be arranged as multiplets in energy diagrams. Many of the closely spaced lines appear to have originated by the splitting-up of a 'normal' energy level because of the influence of the electrostatic fields of the neighbours of the gadolinium ions, principally by the water molecules. We are led to this conclusion by the small change induced by the bromide ion. The fact that it displaces the lines in particular groups both toward the short and toward the long wave-length regions practically decides that the Stark levels are shifted above and below the 'original undisplaced' energy level.

SAMARIUM.—$SmCl_3 \cdot 6H_2O$ was prepared from a salt of samarium of unusual purity kindly furnished us by the late Prof. C. James, of New Hampshire College. At room temperature its spectrum consisted of diffuse lines and bands mostly in the region between 3000 A. and 5000 A. Upon lowering the temperature the lines sharpened and the bands became narrower. At the temperature of liquid hydrogen the lines were exceedingly fine, and the uneven intensity of the few remaining bands suggested a complete resolution into lines if the temperature were further reduced. At the low temperatures some lines disappeared and new lines, all extremely sharp, made their appearance. The appearance of a new spectrum and its increasing prominence, at the lower temperatures, confirmed the expectations derived from magnetic measurements about to be published by one of us. They show that samarium ion in the solid state is a mixture of electronic isomers. A considerable proportion of the samarium ion (the ratio varying with the temperature) is present in each of two distinct electronic levels differing very little in energy.

The spectrum which disappears as the temperature is lowered is due to the thermally excited state, and the new sharp lines which become more intense as the temperature is reduced reveal the presence of the ion that is more stable at the lowest temperatures.

ERBIUM.—$ErCl_3 \cdot 6H_2O$ was recrystallised several times from an erbium salt marked pure by the Welsbach Company. Its spectrum at room temperature consisted of very diffuse bands, but at the temperature of liquid air, and especially at that of liquid hydrogen, the bands became resolved into lines of extraordinary sharpness. These lines clustered in groups, and the latter were separated by rather large intervals. The structure of the groups did not suggest band spectra of gaseous molecules, but rather the multiplets of gaseous atoms under the influence of external fields. Very few lines were found below 3000 A.

We are extending this work to include the other rare earths and are studying especially the influence of other negative ions and of water of crystallisation on the various spectra. This work promises quantitative information concerning such influences of far greater sensitivity and accuracy than can possibly be obtained by the use of the double X-ray spectrometer with which many similar investigations are being undertaken.

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Knock Ratings of Pure Hydrocarbons

MESSRS. BIRCH and Stansfield have been good enough to send us a copy of their letter in reply to our communication which appeared in NATURE of Feb. 23. Our remarks on the knock rating of pseudo-cumene are taken from the Aeronautical Research Committee Report and Memorandum No. 1013 (1925), in which it is stated that the addition of 5 per cent by volume of this hydrocarbon to a common No. 1 petrol lowers the H.U.C.R. of the latter to the extent of 0·4 per cent, whereas the addition of the same amount of benzene raises the H.U.C.R. by 1·0 per cent.

With regard to the figures quoted by Mr. Birch and Mr. Stansfield for trimethyl-ethylene and diamylene which do not agree with our own, it will be observed that our figures refer to concentrations by volume, whereas theirs refer to concentrations by weight. Therefore, the two sets of figures do not allow of strict comparison, because relations between concentration and anti-knock value are often not linear and because of the comparatively large difference in the specific gravities of the two hydrocarbons concerned.

The observation that an acid refined unsaturated spirit has a lower anti-knock value than the original is readily explained by the fact that quantitative conversion of olefines to polymers is never attained in ordinary refining practice. Especially is this the case with the butylenes, amylenes, and hexenes, the hydrocarbons in question; in fact these substances are largely removed by the acid in the form of sulphuric esters. Many references have been made of late in the American scientific press to the relative merits of the various methods of anti-knock engine testing commonly used, and it has often been observed that exact correlation of the results obtained by different methods is frequently difficult to obtain (Edgar, *J. Soc. Aut. Eng.*, 22, 1, 41; 1928: MacCoull, *Oil and Gas J.*, May 10, 1928, p. 208). Edgar has pointed out that the apparent discrepancies are probably due to the different fuel-air ratios employed. It will be apparent that the addition of 20 per cent of such a volatile substance as trimethyl-ethylene (B.P.

38·42° C) will raise the volatility of any spirit in which it is dissolved to a quite appreciable extent, and, because of this, the strength of the explosive mixture reaching the engine cylinder will be considerably altered unless precautions are taken to prevent this or unless the air-fuel ratio is standardised in some way.

It is highly probable that the difference between our figures for trimethyl-ethylene and diamylene and those quoted by Mr Birch and Mr Stansfield is due to such an effect. Suffice it to say that in our determinations with the Delco testing unit fitted with the Midgley and Boyd bouncing pin the technique adopted was the same as that used by the Anglo-American Oil Co and its associated American interests, and embodied the important recommendations on mixture strength recently made by Campbell, Lovell, and Boyd (*J I E.C* **20**, 1045, 1928) The samples of trimethylene and diamylene we used for the engine tests possessed the following properties, which show good agreement with those recorded in the literature.

Diamylene.	B.P. 150-156° C.
	$D.\frac{20°}{4°}$·8112.
Trimethyl-ethylene.	B P 38·3–38·5° C.
	$D\frac{15°}{4°}$·6669.
	$N.\frac{15°}{D.}$ 1 3910

We agree with the necessity of ensuring that all hydrocarbons are free from peroxides before conducting engine tests owing to their extreme action in promoting detonation (Callendar, *Engineering*, pp 147, 182, 210, 1927, Mardles., *J.C S*, p. 872, April 1928.)

We are very interested in the observations of Mr. Birch and Mr Stansfield on the auto-oxidation of cyclohexene We have observed that cyclohexene possesses a greater affinity for gaseous oxygen than the straight chain olefines (cf. Stephens, *J A.C S*, **50**, 568, 1928), nevertheless pentene-2 and trimethyl-ethylene as well as cyclohexene both decolorise indigo solution and liberate iodine from aqueous hydriodic acid and feebly acidified potassium iodide after exposure to ordinary light and air for a few days Refluxing the hydrocarbons over sodium for some hours destroyed this action, but products of auto-oxidation were again detected after a short exposure to ultra-violet light Oxidation products such as peroxides and aldehydes have been detected in a cracked spirit long before any formation of gum or any discoloration has been apparent.

We have also observed that the two olefines di-isobutylene and diamylene react with gaseous oxygen under the action of light much more slowly than do the simple olefines such as the pentenes, while pseudo-cumene and m-xylene, aromatic hydrocarbons which have not the anti-knock properties of toluene, suffer auto-oxidation very quickly. It therefore appears that in the olefine series, and perhaps in the aromatic series also, ease of oxidation is intimately connected with anti-knock action, and in this connexion the phenomenon of auto-oxidation is especially interesting, having in mind the results of experiments recorded by Callendar (loc cit). This investigator has shown that peroxides and aldehydes are products of incipient oxidation during the compression stroke of an internal combustion engine, and that the extent of such oxidation is an important factor in the knock rating of any fuel. Messrs. Birch and Stansfield's views about the compactness of the molecule among isomerides on knock-rating are clearly complicated by their remarks on the behaviour of certain members of the aromatic series We feel that insufficient work on this subject has yet been published upon which to base such a generalisation which will apply to hydrocarbons of all types.

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The Boundary of the Solar Chromosphere.

IN connexion with the theoretical side of the question discussed by Mr R W. Gurney (NATURE, Feb. 16, p. 240) and further by Prof. F J M. Stratton and Mr. C. R Davidson (NATURE, Mar 2, p 318) the following points may be of interest

In a paper shortly to appear (*Monthly Notices, Roy. Astr Soc.*, March) I have tried to interpret the recent published measurements of the hydrogen chromosphere. At present it is only possible to give orders of magnitude. However, putting together the observations of Davidson and Stratton (*Mem. Roy. Astr Soc.*, **64**, 105, 1927) and Davidson, Minnaert, Ornstein, and Stratton (*Monthly Notices, Roy. Astr. Soc*, **88**, 536; 1928), on the Balmer series and associated continuous spectrum, with those of Pannekoek and Minnaert (*Verh d Kon Akad. Amsterdam*, **13**, No 5, 1928) on the absolute intensity of the H_γ line, one concludes that at the base of the chromosphere there are about $2{\cdot}2 \times 10^{10}$ ionised atoms of hydrogen and about 6200 atoms in the Balmer state, per cm^3 (Stress is not to be laid on the precise number 2·2, which is only an estimate of the order so far as it can be derived from the present state of observation and theory) Now, *were* there thermodynamic equilibrium, these two numbers would be characteristic of ionisation at almost exactly 5000° K.

The chromosphere is not in thermodynamic equilibrium, but I give reasons (loc cit and *Proc Camb. Phil Soc*, **24**, 506, 1928) which I believe show that the various properties, atomic motion, distribution among stationary states, degree of ionisation, all define temperature parameters of the same order, say, to give rather wide limits, 4000° to 6000°, which is also the order of the temperature of the incident solar radiation This agrees with the above numbers.

I venture to suggest that these considerations explain why chromospheric Ca^+ at the low pressures given by Prof. Milne's theory is not largely ionised to Ca^{++}. Milne explains it by the removal by gravity of the Ca^{++} ions as soon as they are formed, but I believe it is due to the fact that the large excess of hydrogen ions and electrons gives the Ca^{++} ion a vastly increased chance of recapturing an electron. I find that if the Ca^+ were in equilibrium at 5000° with these $2{\cdot}2 \times 10^{10}$ free electrons per $cm.^3$ it would be only 4·7 per cent ionised, and I conclude that the order of ionisation must be the same in actual chromospheric conditions.

So long, therefore, as the hydrogen provides enough electrons to keep the ionisation of the Ca^+ fairly low, I conclude the type of equilibrium of the calcium is that given by Milne's theory. But as we ascend in the chromosphere and the number of electrons decreases we expect a departure from this type to set in until, at sufficient heights, the increased ionisation prevents it holding any longer. The radiation pressure on the calcium presumably then becomes negligible

These considerations support Mr. Gurney's view that there must be a sharper upper boundary to the calcium atmosphere than former theory predicted. They show, however, that ionisation, and not, as he tentatively suggests, the 'coefficient of partial support,' is probably the determining factor.

Unfortunately, one cannot discuss the height of the

Ca^+ layer, since one does not yet know the density law of the ionised hydrogen. Pannekoek and Minnaert's work indicates it only so far as 3000 km. approximately, and precludes extrapolation by suggesting that their empirical law for H_γ ceases to be valid at that height.

This work, too, it may be mentioned, gives a fairly rapid falling off of the hydrogen line intensities with increasing height in agreement with Mr. Gurney.

I attempt a discussion of the equilibrium of the hydrogen in my paper, but reach no positive conclusion. W. H McCrea.

Gottingen, Mar. 5.

Insects Flying to Ships.

All those who have travelled about the world in recent years must have noticed the insects which fly to ships at anchor, attracted by the bright electric lights. Some years ago I secured a most interesting series (including a new species of moth) off the coasts of Chile and Peru, and in many other places have made collections where I could not go ashore The most remarkable occasion of this sort was perhaps at Diamond Harbour, on the Hooghly River, near Calcutta, in December 1927. Going up, we waited some time, and again going down (on the way to Rangoon) The latter delay was caused by a railway accident in France, which prevented the through mails from arriving in time, so we had to wait until they were brought out in a tender some time in the night. Thus the deplorable accident brought good fortune to an entomologist travelling in India—a curious example of the interdependence of things Diamond Harbour is not really a harbour, but merely a station on the river where ships anchor to await favourable conditions, with the shore distant perhaps half a mile.

The insects which came on board at Diamond Harbour were of various orders, but I will now only enumerate the remarkable series of Carabidæ or ground beetles, and a few beetles of other families, all identified for me through the kindness of the Imperial Bureau of Entomology. The Carabidæ were determined by Mr. H. E. Andrewes, the well-known authority on this group.

Carabidæ

Casnoidea cyanocephala Fb.
**Chlvina tranquebarica* Bon.
**Tachys impressipennis* Mots.
Tachys unistriatus Putz.
Apotomus hirsutus Bates.
**Oodes westermanni* Laf.
**Diplocheila impressa* Fb.
**Diplocheila polita* Fb
Liodaphus birmanus Bates.
**Anoplogenius microgonus* Bates.
Anoplogenius new species.
**Stenolophus smaragdulus* var. *quinquepustulatus* Wied.

Andrewes has just published a long list of the Carabidæ of Ceylon, which includes, of the above list, those marked by an asterisk. Will some of the others presently reach there on ship-board, and is it possible that some already noted in both lists were carried to one or the other place on ships? Three of the above genera are at present apparently absent from Ceylon

Some other beetles represented at Diamond Harbour were·

Cicindelidæ: *Cicindela sexpunctata* Fb.
Staphylinidæ: *Pæderus fuscipes* Curtis; *Philonthus quisquiliarius* var *inquinatus* Steph.
Mycetophagidæ: *Litargus varius* Grouv.
Donaciidæ: *Donacia delesserti* Guér.
Halticidæ: *Chætocnema concinnipennis* Baly.
Hispidæ. *Hispa armigera* Ol.

It is a remarkable fact that both the species of Staphylinidæ cited also occur in Britain, and *Pæderus fuscipes* also flew on to the ship when we were anchored off Sourabaya, Java, on Mar. 7. Who can doubt that these have been spread by shipping?

We have in recent years heard a great deal about the spread of insects by automobiles, but perhaps we have not always appreciated the important part which must be played by ships, now that the vessels are so large, and carry so many electric lights I suggest that travellers, even if not entomologists, might frequently do a good service by collecting the insects coming on board; especially the beetles, which need only to be put in a small bottle of alcohol A more ambitious but interesting project would be to take out a small vessel with a bright light and determine just how far from the shore insects of different kinds can be attracted T D A. Cockerell.

University of Colorado,
Boulder, Jan. 29.

Fine Structure Absorption Edges in Metals.

It is well known from the experiments of Lindh and others that when pure metals are examined, in general no fine structure edges (as distinguished from the secondary absorption edges) are observed If, as is generally believed after Kossel, the fine structure edges originate in the removal of the electron from the K shell to the various optical levels in the atom in question, it is difficult to understand why these edges should be absent in them The non-appearance of the fine structure edges when metallic plates or metallic crystals (in the form of powders) are used as absorption screens can be explained on the hypothesis of the existence of free electrons in metals. The primary absorption edge originates from the removal of an electron from one stationary orbit inside the atom to another optical orbit, both these orbits possessing definite energy value

In metallic plates the outermost electron or electrons may be supposed to be free, and as such the optical levels of definite energy values, as are usually observed in the vapours of these metals, can have no real existence The removal of an electron by the absorption of radiation from the K shell to the periphery of the atom simply sets the electron free from the atom, and unless the former has sufficient energy it will be confined to the metal itself. The extra energy necessary to take the electron out of the metal depends on the nature of the material and the crystal lattice, and is generally of the order of 4-5 volts Thus not only the fine structure according to Kossel will be absent in metals, but also the most intense position of the white absorption will be confined to a range (of about 4-5 volts) smaller than the ionisation potential of the atom in question.

This statement is supported by the works of Fricke (aluminium and magnesium), Lindh (potassium, titanium, vanadium, chromium, manganese, and iron), and Chamberlain (titanium, vanadium, and chromium) in metals Though we may not have fine structure edges of metal as predicted by Kossel, which should appear only in vapours of these elements, one can surely expect secondary absorption edges of these metals caused by the multiple absorption of the incident radiation by two or more electrons occupying different energy levels of the atom under consideration (see Ray, Nature, Nov 17, 1928, p. 771, Lindsay and Voorhees, *Phil Mag.*, November 1928).

In vanadium metal, Lindh has observed a secondary absorption edge with a separation of 8 7 volts from the primary. Evidently this edge cannot be included under the category of Kossel's fine structure edge,

as the ionisation potential of vanadium is only 6·5 volts. A rough calculation shows that this edge originates from the double absorption of the radiation by the electrons in the K and M shells, the energy value of the latter being of the order of 8-9 volts.

The case of non-metals and solids from this point of view will be discussed separately

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Origin of the Ultra-violet Beryllium Hydride Band Spectrum.

THE beryllium arc in a hydrogen atmosphere emits two band systems—one in the green region at 4800-5120 A., and the other one in the ultra-violet from λ3700 and extending as far as can be reached by quartz optics. Very recently both band systems have been measured and analysed by W. W. Watson (*Phys. Rev.*, **32**, 600, 1928), and independently of this, M. Petersen (*Phys. Rev.*, **31**, 1130, 1928) has given a short account of the green system Both investigators state that this system belongs to an electronic transition $^2P \rightarrow {}^2S$ of beryllium hydride, thus apparently corresponding to the long set of well-known band systems emitted by hydrides of magnesium, calcium, zinc, cadmium, and mercury. The ultra-violet system was analysed by Watson only in the region λ3700-2700 and thus permits no definite statements regarding the pure electronic transition, $n'=n''=0$, which falls below λ2700. However, as pointed out by Watson, the investigation of the band $n'=n''=0$ is necessary for information regarding the origin of the ultra-violet system. Watson hesitates between two alternatives: the ultra-violet system emitted by beryllium hydride having a common final state with the green system $^2S \rightarrow {}^2S$, or belonging to an ionised BeH^+ molecule, the transition being of the type $^1S \rightarrow {}^1S$.

More than a year ago I was engaged upon an investigation of the band spectrum of beryllium oxide (*Arkiv for Mat.* etc., Bd 20 A, 1928), and in the course of work was led to study the spectrum of beryllium hydride. From this point of view I was interested in the two alternatives mentioned above. The ultra-violet system was photographed by a Hilger quartz spectrograph E_1 which gives the spectrum completely resolved down to λ2200 A large number of bands belonging to the final vibrational state $n''=0$ [$0\rightarrow 0$, $1\rightarrow 0$, $2\rightarrow 0$, $3\rightarrow 0$, $4\rightarrow 0$], were measured and analysed. The values of their final rotational term differences $2\Delta F''$ definitely rule out the first alternative given by Watson. Both $2\Delta F'$ and $2\Delta F''$ can be represented by the ordinary formula $2\Delta F = 4Bj + 8Dj$.

The $B^{(n)}$ values so obtained are here given.

$$2B'_n = 14{\cdot}45 - 0{\cdot}31n', \quad 2B''_n = 21{\cdot}7 - 0{\cdot}62n''; \quad (n=\tfrac{1}{2}, \tfrac{3}{2}, \ldots).$$

For the green system the values obtained from the measurements by Watson and myself are:

$$2B'_n = 20{\cdot}9 - 0{\cdot}65n', \quad 2B''_n = 20{\cdot}5 - 0{\cdot}55n''.$$

The differences in the final states of both systems, though small, are very distinct The 0-lines ($\nu_0 = P\tfrac{1}{2}$) best fit the formula:

$$\nu_0 = 39417{\cdot}1 + [1476{\cdot}6n' - 14{\cdot}9n'^2 - 0{\cdot}42n'^3] - [2221{\cdot}9n'' - 41{\cdot}3n''^2](n=\tfrac{1}{2}, \tfrac{3}{2}, \ldots).$$

The nuclear separation of the molecule as calculated from B_0'' is $r_0'' = 1{\cdot}31 \times 10^{-8}$ cm.

From what is mentioned above I think no objections can be raised to the statement that the known systems are emitted by two different molecules. As the only possible origin for the ultra-violet bands there remains the ionised BeH^+ molecule. This is also in agreement with the fact that the bands are formed by singlet series, the transition being of the type $^1\Sigma - {}^1\Sigma$.

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An Optical Method for Analysing Photographs of α-Ray Tracks.

FOLLOWING a suggestion from Dr. A. v. Hippel, of the University of Jena, I have tested the following optical method of analysing the right-angle views of α-ray forks. The double camera for photographing α-ray tracks is represented diagrammatically in Fig. 1.

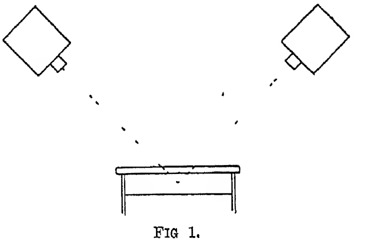
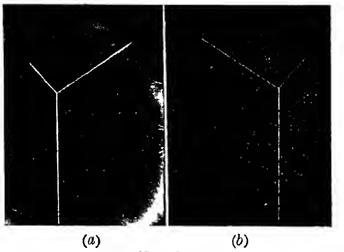


FIG 1.

These cameras take two views simultaneously on separate negatives. In order to secure a full-sized image of the α-ray track in the plane in which it occurred, it is only necessary to replace the developed negatives in the camera and project them on the focal plane By adjusting and rotating a thin translucent screen, a position is found where no part of the composite image appears double The screen is then in the proper plane. This adjustment is very sensitive, even slight displacements of the screen from the correct position affecting some part of the image.

It is very easy to secure a permanent record of the projected image of the α-ray track by replacing the screen by a photographic plate. A photograph thus obtained is of course actual size and should correctly reproduce all angles of the track in the plane in which they occurred. Fig. 2 (*a*) shows a photograph of a model track which was secured as outlined above, the plane of the model being inclined at 30° to the horizontal when the original negatives were made. Fig. 2 (*b*) is a direct photograph of the track itself taken actual size in the ordinary way. Within usual limits of error the two are identical.



(*a*) (*b*)

FIG. 2.

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Solar Diffraction Spectrum from a Single Strand of Cobweb.

The following account of an unusual observation of the solar spectrum seems worthy of record in the pages of Nature: Recently, in brilliant sunshine, I was taking a country walk, and after walking northwards for a mile or so I turned towards the sun. The dark shadow-side of a hedge-bank was close in front, and at once I saw—through my spectacles, clearly projected against the dark bank—a brilliant vertical strip of the solar spectrum. Naturally thinking this to be due either to scratches or dust on the glass, I took off my spectacles and was surprised to see a single strand of cobweb stretched horizontally across one lens between the two frame-attachments, not touching the glass On replacing the spectacles and raising and lowering the head through a range of about 70° or 80° it was easy to see the first and second orders of the diffraction spectrum, and part of the third The first order appeared, violet uppermost, when the head was raised, the sun being at an angle of about 20° or 30° above the line of direct vision As the head was gradually lowered the second order commenced as a hazy light overlapping the red end of the first order, then the second order blue and green shone out brilliant and pure; and, on further lowering the head, the unusual colours produced by the superposition of the yellow, orange, and red of the second order upon the violet and blue of the third, appeared with remarkable beauty.

So far, there is nothing new, for one has often seen diffraction spectra produced by scratches on a window pane, for example in a railway carriage; but the succeeding part of my observation is new to me · A sudden brief period of dead stillness allowed the stretched cobweb to stop vibrating in the breeze, and then appeared brightly and definitely (though somewhat out of focus, because, though myopic, my minimum distance of clear vision is 4 or 5 inches) the familiar lines of the solar spectrum, or rather the bright spaces between the lines The strip of spectrum, which had appeared as a rectangle about ten times as long as its breadth, with clean-cut edges, now appeared widened by irradiation at every bright space.

Being a spectroscopist of some experience I could definitely recognise the 'pattern,' especially in the bright yellow-green and in the strongly marked portion of the blue, and, as the observation was several times carefully repeated whenever a dead-calm interval occurred, there can be no doubt of its reality. On moving the head slightly from side to side I found that the cobweb was evidently finer and more polished in certain parts, and these parts gave a very bright spectrum with very marked alternations of light and dark

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Pollination of Species of *Primula*.

Darwin (1862) showed that in some species of *Primula*, which are dimorphic (heterostyled), a cross between like forms was less fertile than that between the two forms In other species the heteromorphic and homomorphic crosses are equally fertile.

Primula obconica is of the first type; a short-styled plant crossed with another short-styled plant or a long-styled with a long-styled produces no seed, while long-styled by short-styled and the reciprocal is fully fertile

The following facts suggest that the physiology of the relationship of male gametophyte and style is the key to the situation.

Pollen of a long-styled plant will not germinate upon a long style of *P. obconica* Pollen of a short-styled plant will germinate, but the pollen-tubes will not penetrate far into the stigmatic tissue of a short style. Pollen of either short or long-styled plants will produce excellent tubes in the styles of opposite type. Upon agar-agar and 12 per cent cane sugar medium, pollen of long-styled plants only germinates to the extent of 15 per cent, while pollen from short-styled plants germinates to the extent of 75 per cent. The succeeding growth of pollen tubes of the two types is in accordance with the germination percentages.

In *P. sinensis*, in which the homomorphic and heteromorphic crosses are equally fertile, the pollen tubes of short and long-styled plants grow equally well on both types of style In media there is no observable difference in the behaviour of the two types of pollen.

Similar work on other species is proceeding.

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The Electronic Charge *e*.

In a letter to Nature of March 2, Dr. R T. Birge has pointed out the difficulty of reconciling the experimental value of 137 2 of $hc/2\pi e^2$ with Prof Eddington's theoretical value of 136. He concludes that it is highly improbable that any of the measurements of the three physical quantities involved could be so much in error The only other possibility seems to be that the value of π we calculate for practically zero field is not the value that should be inserted in obtaining the value of $hc/2\pi e^2$.

It is, of course, well known that in a radial gravitational field, the value of π is less than the ordinary value. Unfortunately, however, if we imagine that owing to the gravitational attraction of an electron we should use a smaller value of π in calculating $hc/2\pi e^2$ it will only make the discrepancy between experiment and theory worse. In any event, the mass of an electron is so small that its effect on the value of π would be completely negligible. Is it possible that the intense electric field near the electron could have the reverse effect on the value of π, and thus bring the two values into agreement? This idea may appear rather fantastic, but is perhaps worth some consideration.

J. H. J. Poole.

Trinity College, Dublin.

The British Museum (Natural History).

Many biologists will be grateful for the two weighty leading articles in Nature of Mar 16 and 23, on the British Museum of Natural History and on the Museums of South Kensington This letter does not purpose to discuss the important questions therein raised nor the conclusions drawn, but merely to dispel a possible confusion, which may arise in the mind of the reader of the earlier article, between editorial opinion and the unanimous resolution of the meeting of British zoologists

At that meeting, as the article in Nature of Mar. 16 indicates, it was shown clearly that it is the strong and unanimous desire of zoologists that the British Museum of Natural History shall be independent of the British Museum of books and antiquities and on completely equal footing.

On the desirability or otherwise of (1) changing the Trustees, (2) coming under a government department, or (3) being ruled by a council of experts, zoological opinion was shown not to be unanimous. On these points no resolution was passed.

Geo. P. Bidder.

Cambridge, Mar 24.

Co-operation in Science and Industry.[1]

By Prof J. F. THORPE, C.B.E , F R S.

THE past ten years have witnessed a wonderful development of organised industry and organised science in Great Britain, and although conditions are still rapidly changing it is nevertheless possible to look forward and in some measure to determine the position in which we stand and the prospects for the future The War, although one of the greatest economic disasters the world has yet experienced, gave without question a stimulus to discovery and production which no other event could have occasioned. Especially was this the case in the engineering and chemical industries, for the need of new appliances and methods, and the necessity for producing in large quantities and in the shortest possible time, caused the keenest intellects to be brought to bear on the problems at hand, and led to the discovery of new and important processes many of which have now been introduced into industry

It is a principle conceded now even by the enlightened leaders of labour that the universal demand for a higher standard of living necessitates a general increase in the national productive capacity, the term 'productive capacity' being used to mean the capacity to render available the potential wealth of the nation in a suitable form It is chiefly to the chemical and allied industries, mining, metallurgy, etc , that Great Britain turns, because it is their peculiar function, aided by the engineer, to make available its mineral, vegetable, animal, and atmospheric wealth. Provided chemical and allied industries are properly organised, they should be in a particularly strong position not only to increase the availability of wealth, but also to guide national policy in questions strongly affecting material prosperity The age is at hand, if it is not already here, in which the changing majorities of governments will no longer be able to determine major policies as of war, financial and fiscal, except in directions approved by organised industry Control by those who hold the keys of national prosperity, that is, of organised industry, is one of the alternatives to class control and is not only a desirable but also an eminently practicable ideal To achieve it science and industry must organise so that they may become strong politically and financially.

Four kinds of co-operation are essential to strength: (1) internal co-operation, (2) co-operation with pure science, (3) co-operation with Government, (4) co-operation with labour The last, that is co-operation with labour, is a human question rather than one of science or of policy dependent on science and need not be further discussed, especially since enlightened opinion on the part of employers now realises that labour relations are as vital to prosperity as any other factor

[1] From the presidential address delivered at the annual general meeting of the Chemical Society on Mar 21

INTERNAL CO-OPERATION.

Apart from more purely chemical or scientific factors, there are two immediate advantages to be gained by the formation of big combines, in the pooling of capital and the pooling of engineering resources, the establishment of a balance in commodities produced and in the method used for their production being determined mainly by chemical and engineering conditions

The standardisation of methods and the coordination of interests as regards production and distribution, the question of price and the prevention of over-production are problems which mainly concern the business organisation of industry, and do not directly affect the relations between industry and science Yet their importance is manifest, and in some instances, especially in connexion with the standardisation of methods, the help of the chemist is essential The need for obtaining a balance in all these factors, a consummation which can only be reached by a pooling of like interests, is obvious

Probably the best example of the common use of a chemical substance by a number of different manufacturers is that of hydrogen, which is at the present time used in vast quantities for the production of (*a*) methyl alcohol, (*b*) liquid fuels from coal, (*c*) ammonia, to mention three of its most recent applications In pre-War days it was used in large quantities, and still is so used, for the hardening of fat Nevertheless, the three industrial operations mentioned also represent in a remarkable degree examples of progress and development that have taken place within the last ten years

At the present time we know nothing of the reasons which determine the action of a catalyst, and although we have to hand a vast number of reactions which may be regarded as reasonable and likely to occur should the right conditions be discovered, the search for a catalyst is always attended with difficulty and often ends in disappointment. Prior to the original German patent for the production of methyl alcohol from carbon monoxide and hydrogen, many attempts had been made to realise this very simple reaction even on the laboratory scale.

Other reactions readily suggest themselves, such as, for example, the formation of acetic acid from methane and carbon dioxide. As a matter of fact, this, and other reactions of a similar type, forms the subject of patent specifications, but whether they have been actually realised experimentally must remain an open question in the absence of definite evidence. Our patent system unfortunately lends itself admirably to the production of 'blocking' patents, and there is no subject so suitable as organic chemistry as a medium for such patents.

Co-operation with Pure Science.

Training.—Chemical trade is at present in the midst of the most rapid expansion it has ever known and nowhere is the development more noticeable than on the research side. This is as it should be, for the researchers are the scouts and it is essential that they should be far ahead of the army (the working process) It is necessary also that the scouts should operate on a broad front in order that no channel of advance should be overlooked merely because it does not lie in the expected direction. The realisation of this principle by the greater manufacturers has led to a strong demand for university-trained men, and the number of research chemists in industry in Great Britain has been estimated at twenty times the number before the War, the demand is still increasing The universities have had and are having difficulty in supplying this larger number of adequately trained men, for they have to fulfil the majority if not all the demands made by chemical industry Manufacturers have come to realise that training should be essentially fundamental and that a wide knowledge of the principles of chemical science is a necessity The vexed question in what manner is this to be attained is being answered by the gradual adoption of at least a four years' course, although the still more important one—that of the post-graduate course—is not yet settled.

A long experience of university teaching has shown me that it is exceedingly difficult to determine whether any particular individual is more fitted to succeed as a process chemist or whether he has that peculiar aptitude which will enable him to carry out effective work in the research laboratory Unfortunately, the positions are not interchangeable. A student who has shown aptitude for research may, if occasion demands, make an excellent process chemist, indeed it often happens that he will have to elaborate a laboratory method so as to place it, with the help of the engineer, on the unit factory scale But it is very doubtful if the individual who has shown that he possesses no aptitude for research can be usefully employed in that connexion excepting under control. The only manner in which the presence of the research aptitude can be discovered is by direct trial, and therefore it is always desirable to subject a student to one year's training in research after graduation in order to discover if he possesses this characteristic

The term 'research training' must be interpreted in its widest sense to include training in special branches of chemistry related to the industries as well as more general training in the higher branches of chemical technology.

Industrial Research in Universities.—At no far distant period in the past the great potentiality for research residing in our university laboratories, and in the personnel controlling them, was not available for industrial purposes. The reasons for this were many. For example, industrial research was not regarded as of sufficiently 'pure' character to allow of its inclusion in the academic curriculum. There was considered to be something essentially different between 'applied' and 'pure' chemistry, and this was emphasised in the 'eighties by the formation of the Society of Chemical Industry as a distinct body from the Chemical Society The Americans knew better than this. They have kept their chemists together as a homogeneous body, and the American Chemical Society with its membership of 17,000 represents in no uncertain manner the considered opinion of the whole body of chemists of that country.

The fault lay mainly with the universities of Great Britain, which were loath to introduce science other than 'pure' into their courses of instruction Hence there arose the multitude of technical schools which were originally intended to supply the need for a vocational training without undue reference to the science upon which the training was based. The establishment of new universities in industrial centres, a period of reform ushered in by the breaking up of the old Federated Victoria University, soon produced a marked change, and research and instruction in the fundamental principles underlying industrial science gradually passed into the hands most competent to deal with them

Industrial research both of the fundamental kind as well as that which arises as the daily outcome of works practice should be and now is carried out for the most part by the firms themselves in their works laboratories But there are a number of problems, mainly of a 'long-sighted' character, which are intimately related to industry. The personnel on the scientific staffs of the universities of Great Britain are people who have throughout their lives specialised in some particular branch of research, and are therefore eminently fitted to solve problems in their special field This is now recognised by many leading firms who supply grants to enable post-graduate research workers to investigate specific problems under the guidance of professors of chemistry and other directors of research laboratories, and in this connexion must be mentioned the far-sighted policy of Imperial Chemical Industries, Ltd., which gives yearly substantial grants to research laboratories in order to enable them to obtain special types of apparatus and appliances which it would otherwise be difficult to procure.

Great advances in the development of scientific industry have been made in Great Britain since the War, and every effort must be made to maintain and strengthen the causes which have led to this condition. From the point of view of national prosperity it is essential that active research centres should be maintained and still further developed in our universities, not only to supply the scientific ability to foster and improve the industries of our own generation, but also to pave the way by discoveries in science for future commercial prosperity.

Team Work—During the War very valuable work was accomplished by means of team work, by which is meant the solution of some problem by the united efforts of a team of workers under a directing head. There can be no question that this

method of attack is usually most effective, especially in a works laboratory where some specific problem may require rapid solution. Its application to the university laboratory is subject to the difficulty that under team conditions the intellectual stimulus which attaches to the individual attack on specific problems is sometimes lacking, and it is in the highest degree desirable that this stimulus should be developed and maintained. Nevertheless, it is always possible so to divide a major problem as to make each section in itself a self-contained research and thus to give each investigator what is essentially a definite subject on which he can work in his own way and according to his own mentality.

Co-operation with Government.

The Government of Great Britain has already discovered the two most valuable ways in which it can co-operate to the benefit of present and future chemical industry, namely, (a) by protecting young and struggling industries against competition from similar but established industries abroad and against competition arising from deflated foreign currency, and (b) by promoting research in pure and applied chemistry by financial assistance Another way in which it has helped the application of science is by the provision of a free chemical advisory service in the interests of agriculture

Research Associations.—There can be no question that the value of co-operative research in industry has been established The Department of Scientific and Industrial Research has, therefore, rendered a valuable service to the industrial community and its initial policy has been fully justified. Nevertheless, the time has arrived when the varying appeal which the necessity for scientific investigation makes to different industries has made itself manifest, and the Department feels that any further support on general lines would no longer be justified. It proposes, therefore, to treat each case on its merits.

Research Studentships and Fellowships.—The call for adequately trained research workers in science, and especially in chemistry, is increasing. It is therefore very disquieting to realise that the policy of the Department in connexion with the provision of maintenance grants for students in training appears to be changing. The outlook is serious, because it is quite impossible for the universities to provide funds for post-graduate training in any way commensurate with the present-day requirements of industry, and as the average science student is usually drawn from a comparatively poor class, it is not likely that the necessary money for an extended course will always be obtainable from parental sources

Every director of a research school has had to tell some promising student who wishes to undergo post-graduate training and is, without question, likely to profit by such training, that no funds are available to enable him to extend his course and that he must, therefore, seek any minor post that may be open to him. The loss of such a man is a national loss, because his training is broken off at the stage where even one extra year would have enabled him to become a useful member of a research organisation, whereas, in the circumstances, he has to take up some position, probably one involving merely routine work, where the value of his early training will be lost and his initiative and enthusiasm destroyed. It is therefore to be hoped that the diminution in the number of research grants is merely a temporary expedient and that it does not indicate a reversal of a policy which has proved so fruitful during the past twelve years and has shown itself to be an essential part of research development in Great Britain.

The Functions of the Human Skull [1]

By WILFRED TROTTER

THE development of science involves the two processes of collecting facts and of elucidating their relations. In the early days common experience so abounded with unrelated facts that an alert and contemplative mind was an adequate equipment for the man of science and could readily find material for generalisation. Knowledge was like an unexploited gold-field, in which the mere attentive wanderer might pick up nuggets of the metal So were made the earliest discoveries in mathematics, astronomy, and physics When the surface of the field no longer yielded such finds, the digger with his simple and homely outfit could still from easily accessible deposits gather with his own hand gold dust by the ounce and pound. This was the Golden Age of science, it lasted somewhere about two hundred years, and was nobly marked near its beginning by the "Principia" and near its end by the "Origin of Species." It was the day of the individual digger, of simple apparatus and the still obvious predominance of the worker's mental quality over every accessory circumstance. It was a time in which relatively simple efforts in the collection of facts might have great results. Looking back at it we discern as a characteristic object Wollaston with his laboratory on a tea-tray, and as a characteristic incident Hans Christian Oersted noticing in 1819 the deflection of the magnetic needle by an electric current—an experiment it would not be very extravagant to call the most important event of the nineteenth century, or as not less characteristic Joseph Fraunhofer in 1814 observing and thinking it worth while to map out the dark lines in the solar spectrum—a dull-looking task that was, however, ultimately to yield a veritable measuring rod for the universe and a most effective probe of even its stupendous depths.

At the present day what we may call the surface

[1] Lecture delivered before the Anthropological Society of University College, London, on Jan 25.

deposits of truth seem almost everywhere to have been worked over, and ours is the time of the thousand-yard shaft, the mile-long gallery, the battery of stamps, and the pennyweight yield to the ton. The mere collection of facts has become a difficult and elaborate enterprise, to which the solitary worker is rarely equal In almost every branch of science complex equipments are necessary, the mere use of which may need years of training Even genius itself is no longer inspired by the falling apples and spouting kettles of the Golden Age, the powers of Einstein are called out by the quintessential zero of the Michelson-Morley experiment, or those of Bohr by the incredible vacancies of the atom.

Since the merely observational half of the scientific act has become so formidable, it is natural that the other half that comes of the speculative, contemplative, and relating turn of mind should as such have sunk somewhat in general esteem. It is perhaps correct to say that, among scientific people, work of any general speculative kind is a little under suspicion unless it is closely associated with actual observation as well, and that anyone who tries to correlate large groups of facts is unlikely to be listened to with great attention unless he has been concerned at any rate to some extent in the collection of the facts themselves. This attitude of the mind is on the whole sound and practical, but it should perhaps be qualified by two small reservations In the first place, the justified predominance of observation may lead to a certain frigidity towards ideas as such, and even some risk of the automatic rejection of them

In the second place, it must be remembered that there are still some few 'alluvial' deposits left unexhausted in the gold-field of truth Here the observational side of scientific work may seem when judged by modern standards primitive and 'uneconomic,' and yet it may be capable of yielding appreciable finds. One such deposit is the great range of human behaviour, in which we all can be adequately skilled observers and need no more than the critically selective and relating turn of mind. Other such opportunities are apt to occur along the line where two fields of observation meet Medicine has many such lines of meeting with the sciences, and its contact with anthropology is one of the most obvious. Medical men are interested in the same animal as are anthropologists and have to study it with some intensity.

When we study the boundary zone of two adjoining departments of knowledge, we may expect to find what instruction we are to get not so much in learning strictly ordered and documented facts as in getting fresh points of view, we may hope that the well-established and matter-of-course fact or principle from one side of the line may prove new and illuminating when viewed from the other side

In such a study, then, we shall do well not to be too exacting in proof or too systematic in method. We must be willing to accept new light where we can find it, and to remember the old paradox that in science the primary duty of ideas is to be useful and interesting even more than to be 'true.' We must be ready to entertain ideas freely and fairly, and no less ready to discard them without regret, glad enough when we gain an unexpected glint from "the blank face of familiar things" It will be with very limited pretensions, therefore, that certain considerations derived from surgical experience will be set out here Nothing could be less dogmatic than the spirit in which they are put forward or more submissive to the principle of the aphorism, "Do not believe new ideas, use them"

While the essential object of all biological knowledge is the elucidation of function, the work of the surgeon is actually engaged in the direct study of function in a very special degree. He is concerned with the human body solely as a going concern and his unique object is to keep it going In regard to the cranium, he has no direct interest in its size, its form, its types, its indices; he limits himself, with what for the anthropologist must seem a certain crudity, to the question what does it do? In the briefest possible terms, the cranium is to the surgeon the *capsule* and *the skeleton of the brain*.

The Capsule of the Brain

It is not usual to regard the brain as among the encapsuled organs, but to do so brings out an interesting aspect of its functional relations with the skull. If we consider encapsuled organs in general we at once see that the rigidity of the capsule is an important character. In regard to it, organs may be divided into three groups In the first, which may be called the normal type and is represented by the kidney and spleen, the capsule is fully extensible, in the second, represented by the testis, only very slightly extensible, and in the third, represented by the brain and skull, it is absolutely rigid to all physiological forces Such conditions have necessary and very important effects on the mechanics of the circulation in the various organs There is of course a primary need for the flow of blood through any tissue to be continuous; this is effected in organs of the first group by the extensibility of the capsule permitting pulsation and elastic recoil to occur In the case of the brain, however, a different mechanism is necessary. The brain itself expands with each arterial pulse, but, as the skull is unyielding, room must be made at each pulsation by the expulsion of a corresponding volume of the low pressure intracranial fluids This is why the veins leaving the skull and the cerebro-spinal fluid in the subarachnoid space of the spinal cord show arterial pulsation

The mechanism is adequate, but the margin by which it is so is not very large After violent exertion, when the range of pulsation of the brain is at its widest, we are apt to be conscious of an unpleasant thudding in the head, which shows that the brain can only just find room for its circulatory excursions Again, if one has a slight headache it is at once aggravated by exertion.

This circulatory peculiarity is fundamental in cerebral pathology and makes it possible to say

that, apart from purely destructive processes, all cerebral symptoms are of circulatory origin.

We may briefly inquire into how this comes about. The low pressure outflow that must accompany each arterial pulsation is chiefly in the form of venous blood. For it to occur the flow of blood in the veins must be quite free But the pressure in the veins is very low, so that the least abnormal swelling of the brain or part of it causes collapse and obstruction of a greater or less venous territory Thereupon further swelling from venous congestion occurs and the disturbance of function becomes progressive.

The brain is thus uniquely sensitive to any pathological change in its bulk. When an organ like the kidney is bruised and swells, it matters very little how soon or if ever it gets back to its normal size When the brain has been bruised, it must get back to its normal size or its circulation will remain permanently disturbed. A simple bruise of no ultimate importance to an organ with a yielding capsule, is thus a relatively serious matter with the brain The great difficulty with which the brain recovers from even simple injuries that cause swelling is one of the most important functional consequences of its rigid encapsulation by the skull [2]

THE DEFENSIVE FUNCTION OF THE SKULL.

It is still a widespread opinion, even to some extent among medical men, that fracture of the skull is the most important feature of head injury, and that if the skull is not fractured not much harm can have been done There is no more complete delusion Fracture of the skull is usually an insignificant element in a head injury, and nothing has done more to limit the knowledge of trustworthy principle than the traditional reverence for it

A fracture means that the skull has been distorted until the limit of its elasticity has been passed It is the distortion, and not the crack that may or may not ensue, that is important

Now surgical experience in Great Britain shows that the skull is susceptible to considerable degrees of distortion by even only moderately severe external violence Because immediate and dramatic effects are not always produced, and because of the superstition about the significance of fracture, it is apt to be assumed that the average European cranium is on the whole very successful in preserving the brain within it from the effects of quite severe violence Since the nature of what are called the minor injuries of the brain has been better understood, this faith in the beneficent fortitude of the skull has been considerably shaken We now know that the skull in its protective function is only moderately effective It is liable to bend under local violence and to permit of a localised bruising of the brain beneath , it is also liable in appropriate circumstances, especially such as falls on the head, to a far more serious general distortion This general distortion causes the very interesting instantaneous and transient paralysis known as concussion of the brain, and is also apt to produce a widespread bruising of the brain substance that is of great practical importance. It is important to note that all the evidence points to actual distortion of the skull being the immediate cause of most if not all injuries of the brain. There is no reason to suppose that injury is commonly if ever produced by the brain being thrown about inside an undistorted skull. It is probably true to say in so many words, no distortion of skull, no injury of the brain [3]

This liability to relatively easy distortion seems to be in some special degree a character of the modern European skull. It appears to be fairly clear that in some races the resistiveness is decidedly higher For example, the negro, judged by purely clinical, that is functional considerations, is little liable to receive cerebral contusions from the moderate degrees of violence that an Englishman could not endure with impunity The willingness of the negro to use his head as a battering-ram has often been described, and it is said that an experienced policeman will use his truncheon on the head of a negro less hopefully than he would use it on an English head

We arrive then at the position that the modern European skull is demonstrably far from completely effective in its protective function, and that this defect is not shared by all other races

It will be noticed that we are not at all concerned so far with the anatomy of skulls. It may or may not be possible to show a difference in the thickness or rigidity of European and negro skulls. The test of function is far more delicate and trustworthy than that of structure, and it seems to show that a clear difference exists

We have already seen that the bony capsule of the brain is a serious hindrance to recovery from minor injuries, so that the skull and brain mechanism is satisfactory only when the former is highly effective as a protective covering. Once the protective function is impaired the physiological disadvantages of the arrangement become fully manifest It seems clear, then, that the present functional relation of brain and skull—plainly disadvantageous as it is—must be the result of some strong evolutionary tendency or must be accounted for by some advantage that compensates for it.

In a very broad and general way, it does appear to be the fact that there has been an evolutionary tendency towards a reduction in the massiveness of the human cranium , there can be no doubt that the modern European cranium is in comparison with many of its predecessors remarkably light and thin It is not improbable, therefore, that a tendency towards the lightening of the cranium is an inherent character of the race and progressive. It is natural, therefore, to ask how far such a process could conceivably go The European skull has already discarded a good deal of its protective rigidity , is a rigid cranium a necessary structure ?

[2] It is interesting to notice that the testis—the only other organ in the body that approaches the brain in the rigidity of its capsule—shows the same susceptibility to minor injuries As is well known, it may undergo complete atrophy after a simple bruise.

[3] A contrary opinion is perhaps encouraged by the use of the time-honoured and now ineradicable phrases 'concussion of the brain' in English and 'Hirnerschutterung' in German

The Skeletal Function of the Skull.

Without considering any other matter but function, this question can be given a perfectly definite answer. However much more of its protective massiveness the skull may lose, it must always maintain enough rigidity to preserve its form This is because it is a function of the skull, not the less important for being usually overlooked, to support the brain If we make in the treatment of injury or disease a considerable hole in the skull, and after healing of the scalp is complete the intra-cranial tension is normal, we find a tendency for the soft parts to sink into the cranial opening This depression is most marked when the subject is standing and usually quite filled up when he is lying down. With an opening 3 or 4 in across, the depression may perhaps reach a depth of as much as $1\frac{1}{2}$ in at its centre The larger the opening the greater the depression, and it is clear, therefore, that the exposed brain, when the intra-cranial tension is at its lowest, cannot support the atmospheric pressure and actually collapses under it. In certain cases the subjects of openings in the skull suffer severely from the exaggerated movements of the brain that in them accompany changes of posture. Such symptoms are always abolished when the opening is closed by restoration of the skull

In the cranium, in fact, the vertebrate has rediscovered the principle of the external skeleton and exploited it in a remarkably interesting way that may be worth a moment's consideration. What may be called the constructional problems of such an immense mass of neural tissue as the brain are very complex. The obvious way of supporting a large mass of soft consistence would be the provision of a stiff stroma of ordinary connective tissue Such a solution is inadmissible for very definite reasons. In the first place, direct contact between mesoblastic and neural tissues is a physiological impossibility, so that every strand of the hypothetical connective tissue stroma would have to be clothed, as is every cerebral vessel, with a so-called 'perivascular lymphatic' to its finest ramifications At a moderate estimate this might double the bulk of the whole organ. Again, the presence of an elaborate and alien fibrous network would immensely complicate the system of intercommunication, which is the very essence of the brain as it is How neat a solution of the problem does the exo-skeleton provide With it, it is possible for the brain to be made up almost entirely of actual functional elements, and for the utmost complexity of communication to exist while the bulk of the whole organ is kept within bounds.

The Meaning of the Vulnerable Skull

We have seen that the low strength of the modern European skull is shown by actual experience to be producing serious effects in the way of a high susceptibility to disabling injuries of the brain To discuss the meaning of this remarkable and perhaps a little disturbing state of affairs it is necessary to enter into some rather general considerations.

There can be no doubt that in the growth side by side of the cranium and the brain, the latter is the predominant partner, and what it needs the former must on the whole provide If the skull had no other function whatever but to be the capsule and skeleton of the brain, the correspondence would be absolute and every least developmental variation of the brain would be accurately accommodated by the skull. Now the skull or even the cranium does have other functions to fulfil than those concerned with the brain. It is involved with the muscles of the trunk, with the apparatus of mastication, with the respiratory tract. The provision for these accessory needs must, it seems reasonable to suppose, have some influence however minor on the growth of the cranium, and act as some restraint however minute on the control of it by the brain, and therefore on the freedom of variation of the latter When, therefore, the skull is very massive and deeply involved with accessory functions, when it gives attachment to large neck muscles, when it is ridged and fortified for a heavy masticatory apparatus, the freedom of the brain to develop minor variations is perhaps less complete than when the cranium is stripped to the condition of a mere cerebral capsule

Since it is possible that free variability of the brain through a very small range is of value in fitting man for a complex civilisation, it seems not a very extravagant supposition that the freeing of the skull from accessory functions has been a factor in human evolution

Evolution of the Brain and Skull.

In considering the evolutionary process in general, then, we have to think not merely of a progressive expansion of the cranium to accommodate the increasing brain, but also of a growing independence of the cranium

It seems obvious that the anterior end of the segmental animal was the inevitable site for the chief nucleus of a centralised nervous system The same region was equally inevitably annexed for the entry to the respiratory and the digestive tracts An interesting series of complications has ensued from this necessary crowding of function into one extremity. It does not seem too fantastic to see two tendencies constantly at work and in conflict—the tendency on one hand to make use of the brain skeleton for functions connected with other systems, and on the other the struggle of the brain for autonomy and freedom from these burdens. Wherever the former tendency has been definitely the stronger, the progress of the brain has been arrested and the animal has found itself in an evolutionary blind alley The most striking illustration of this process has been in connexion with apparatus of defence and attack. Such apparatus has a natural and inevitable localisation near the digestive inlet and at the anterior end of the animal Nature in her experiments with horns, antlers, fangs, and tusks has found the skull waiting as a

convenient foundation for these useful but enslaving structures. The ancestors of man, with the steady avoidance of specialisation to which he so largely owes his zoological position, kept their craniums free from such encumbrances.

It was, however, probably the beginning of the upright posture that was the decisive change in favour of the independent skull It has not, so far as I know, been much remarked upon that the upright posture changes the whole mechanics of attack and defence from that of the quadruped The head is withdrawn from the front of the animal, and thus being no longer available as a foundation for offensive or defensive structures, the cranium is at last and finally safe from them Another and more familiar way in which the cranium was helped by the upright posture to free itself from accessory functions was in the limitation in the movements of the mandible that necessarily ensued With a poised instead of a slung skull, the mouth can no longer be opened freely enough for the aggressive use of fangs Thereupon the cranium is no longer called upon to find attachment for the correspondingly massive muscles

When we see an evolutionary tendency so strong as that seems to be which has stripped and lightened the cranium until it has reached the degree of fragility and simplification seen in the modern European, we are inclined to ask whether even yet its force is exhausted There are perhaps signs that even now the cranium is, so to say, intolerant even of the light burden of accessory function it still has to bear. It is scarcely possible to be familiar with the lower jaw of the modern English without wondering whether the unexhausted tendency we have been considering is not at work to free the cranium even of the temporal muscle It is clear that the molar region of the mandible is shrinking, and experience already suggests that 8 fully erupted molar teeth are nearer the actual normal than 12 Since the temporal muscle is especially concerned with the use of the molars, it is perhaps permissible to wonder whether it, rather than the jaw, is not the real object of evolutionary attack.

The tenuity of much of the foregoing speculation must be obvious The argument, however, makes no attempt to be rigorous, and is intended to be illustrative rather than demonstrative The object of it has been to find out whether the old-fashioned method of general qualitative survey might not in so favourable a situation as the frontier between two branches of knowledge, present the familiar facts of one side of the line in a way that would have freshness and perhaps interest on the other

News and Views.

THE Postmaster-General has written an excellent letter, dated Mar 27, to the Baird Television Development Company He states that he has seen a demonstration of the Baird system and that he could recognise with sufficient clearness the features and movements of persons posed for the purpose in the transmitting studio He is a little doubtful whether it is at present practicable to reproduce simultaneously more than two or three individuals, and they must be staged in very close proximity to the transmitting apparatus. In his opinion the Baird system represents a noteworthy scientific achievement. Taking into consideration the present limited scope of the objects which can be reproduced, he does not consider that it is at present practicable to include television in the broadcasting programme in broadcasting hours. He is anxious, however, to give facilities so far as practicable without impairing the broadcasting service for continued and progressive experiments to be made with the Baird apparatus. He consents to a station of the British Broadcasting Corporation being utilised for this purpose outside broadcasting hours. The Company would probably have little difficulty in negotiating satisfactory terms with the Corporation. It is very desirable that experimental demonstrations of television should be accompanied by the broadcasting of speech. Consequently, two wave-lengths and two transmitters are required. It would be very difficult to provide a second transmitter in a suitable locality which would not interfere seriously with important radio services in central London, until the new station of the B.B.C. at Brookmans Park be opened next July. In the meantime, the engineers could jointly discuss the best methods In order to get a television service during broadcasting hours, wave-lengths outside the bands now being used for speech broadcasting must be used. Unfortunately, these bands are much congested. It is important, therefore, that the Company should press on with experiments on as low a band as possible. Purchasers of receiving apparatus are warned that they buy them at their own risk, as the system is not yet sufficiently advanced to warrant giving it a permanent place in the broadcasting programmes.

IT is interesting to learn from a *Daily Science News Bulletin*, dated Feb 26, issued by Science Service, Washington, D.C., of the paternal attitude adopted by the Federal Radio Commission towards the many applicants who are anxious to start television broadcasting in the United States. Eleven licences for television broadcasting have already been granted, but in all cases precautions have been taken that such activity is for a limited period and is purely experimental. The licences are only for six months The broadcasters have to give monthly reports of their activities and of the scientific work they are doing to advance the art. The Commission apparently is not yet convinced that radiovision can render real service comparable, for example, with that of sound broadcasting. They are naturally anxious to prevent anyone broadcasting radiovision with the main purpose of selling radiovision receivers. The Commission has allotted to radiovision, or, as they call it, 'visual broadcasting,' which includes still pictures, 'radiomovies,' and pictures of living actors, four bands of frequencies.

The first two bands are between 2000 and 2200 kilo cycles (136-150 metres) and the other two bands are from 2750-2950 kilocycles A further band between 2200 and 2300 kilocycles for radiovision may also be used in the future provided that it does not interfere with Canadian stations The present radiovision broadcasting stations are situated in New York, New Jersey, Washington, East Pittsburgh and Springfield, Mass., Schenectady and Oakland in California. Many applications are still pending, and hearings will be held to determine "whether or not public interest, con venience, or necessity would be fulfilled by granting their applications." No television broadcasting (that is, by wire) will be allowed on any frequency in the broadcast band, except between 1 A.M and 6 A.M.

At a recent meeting of the Royal Statistical Society, Dr. E. C Snow, who read a paper on "The Limits of Industrial Employment," said that before the War the population of Britain was increasing by about 350,000 a year, but now the annual increase is not much more than half this figure. In ten years time it is estimated that the increase will not be much more than 100,000 per annum. Important changes have taken place in the age distribution of the population. In the decade before the War, 130,000 of the annual increase occurred in the age-group 30-45 (probably the most important period of life as regards the demand for goods for consumption) and only 50,000 in the group above 60. At the present time the former group is increasing by only 30,000 per annum, while those over 60 are increasing by more than 100,000 per annum. These changes, Dr. Snow said, are of importance in the study of the unemployment problem. Modern industry requires a continuously expanding market since many workers are engaged in manufacturing machinery and other capital goods which will help to increase future production. But if population does not increase correspondingly, a state of over-production will arise and this will react on the employment capacity of industries which produce capital goods or their raw materials The effect on employment is cumulative, because those who manufacture capital goods are themselves consumers, and their demand as consumers will be reduced. The effect is the more severe in Britain because this country is far more dependent upon industrial activity for employment than any other

On April 6 occurs the centenary of the death of Niels Henrick Abel, the brilliant young mathematician who died at the early age of twenty-six. Born at Findoe, Norway, on Aug. 5, 1802, the son of a minister, Abel was educated at the Cathedral school and University of the capital, and from the age of sixteen gave evidence of striking mathematical powers. After the death of his father he was supported by the professors, and later by a pension from the government. He travelled into Germany, Italy, Switzerland, and France, became intimate with Crelle, but it is said that his visit to Paris proved disappointing. After his return to Norway, however, Legendre, Poisson, and Lacroix wrote to the King of Sweden on his behalf, but no notice was taken of the letter, and a few months later Abel died of consumption at Arendel "The great point," said De Morgan, "to which Abel turned his attention was the theory of elliptic functions. Legendre, who had devoted a large portion of his life to the development of these functions and the formation of tables by which to use them, found himself, when his toil was just finished, completely outdistanced by the young Norwegian of whom no one had ever heard." The centenary of Abel's birth was celebrated with great enthusiasm at Oslo in September 1902, when honorary degrees were conferred on many men of science, among whom were Kelvin, Rayleigh, Salmon, and Stokes, while in 1908 a striking monument to him was erected close to the University building

The differences of opinion which have arisen on the subject of the management of the New Forest have already been alluded to in Nature The Forestry Commission, on taking over the Crown Forests from the Woods and Forests branch, commenced certain sylvicultural operations in the Forest without reference to local opinion—operations which were viewed with alarm by a certain section of the public The ideas of this section were powerfully voiced by the New Forest Association, which represents, amongst others, the right and privilege holders (*i.e.* the commoners) In how far the New Forest Association can claim to voice the opinion of the general public is open to doubt. It is this view of the question which Mr. H. H Haines, a well-known botanist and formerly a member of the Indian Forest Service, considers in a small pamphlet which he has prepared and circulated to the members of the Society for the Promotion of Nature Reserves, fellows of the Linnean and Royal Societies, and others. Although we are not in agreement with all Mr. Haines's contentions, he presents the case for a correct management of the New Forest in a perfectly straightforward and fair manner. If the absence of all efficient management which has persisted for many years is maintained, the most beautiful parts of the Forest are doomed to disappear Professional opinion is at one on this matter. Since Mr Haines can speak on the sound professional side, whilst being at the same time a botanist and a Nature lover, his small brochure, which unfortunately bears no title, should be read by all lovers of the New Forest.

In the Final Report of the Committee on Industry and Trade, which has recently been issued (Cmd 3282. London: H.M Stationery Office, 1929. 5*s.* 6*d* net), considerable stress is laid upon the benefits which would accrue to industry in Great Britain from the greater recognition of the value of scientific research. In certain other countries, notably Germany and the United States, a very great amount of research is carried out by various industrial associations, corporations, and combines, and even by large individual concerns, though in Britain the importance of scientific research is imperfectly realised by the leaders of industry. In the opinion of the Committee, a change in this attitude would open up prospects to British industry which at present are beyond the

range of possibility. It is true that certain large works in Britain carry out much research work, but for the most part this consists of mere routine testing, or what has been called 'tactical' as distinguished from 'strategical' research, that is, the improvement of results obtained from a given process or the investigation of fundamental laws. The latter has to be undertaken by the State or by co-operative research associations which represent a joint effort of the industries themselves and the Department of Scientific and Industrial Research. The Committee suggests that the most hopeful direction of future development is to define more and more clearly the line of demarcation between the kind of research which is the special function of the State, namely, that concerned with fundamental scientific problems and their application to industry as a whole or to great groups of industries, and that which is the proper function of industrial undertakings either singly or in co-operation.

THE Committee finds most cause for disquietude in the relations between the research associations and the industries themselves, since the response to the propagandist efforts of these associations is frequently most disheartening, even when full allowance is made for difficulties such as trade depression and the expense of installing new plant and processes. It recommends that every important trade association should take into consideration the existing means of disseminating technical and scientific information and, where these are inadequate, should take steps to establish suitable machinery for the purpose. The research associations on their part should engage in a campaign of publicity and explanation in order to popularise their results. There should be some responsible suitably qualified officer on the staff of each firm, whose duty it would be to follow the progress of scientific research as summarised in the bulletins received. It is also essential that at least an adequate proportion of the responsible heads of industry should have the scientific habit of mind, though it is not necessary that they should themselves be trained researchers "Before British industries, taken as a whole, can hope to reap from scientific research the full advantage which it appears to yield to some of their most formidable trade rivals, nothing less than a revolution is needed in their general outlook on science· and in the case of some industries at least, this change of attitude is bound to be slow and difficult, in view of our deeply rooted industrial traditions"

THE wireless organisation for the air mail service to India, which opened on Mar. 30, is such that the aircraft engaged will be in touch with aerodrome ground stations throughout the 4700 air miles of the journey. On the London to Basle section, the present wireless organisation for continental aviation will be employed. The aircraft are fitted with Marconi sets of 150 watts power (Type AD6), adapted for communication over distances of 200 to 300 miles either by telephony or telegraphy. From Basle the night train to Genoa makes the connexion with the second section of the air route, from Genoa to Alexandria, operated by three 'Calcutta' flying boats fitted with the more powerful Marconi Type AD8 sets These sets are also adaptable for telegraphy or telephony, enabling the pilots to keep in touch with Italian and British Air Ministry wireless stations until arrival at Alexandria. In addition, Imperial Airways, Ltd., which is conducting the London-Karachi service, has stationed a depot ship in the Greek Archipelago. This has been fitted with a Marconi valve transmitter of ½ kilowatt power (Type U) and suitable receiving equipment (Marconi Type RG19 Receiver), and will be capable of communicating with Malta, Alexandria, and other stations concerned with the service. At Alexandria a change is made to aeroplanes again for the final section of the route, through Basrah and over the Persian Gulf to Karachi. Part of this section has been in operation for some time, employing De Havilland aircraft fitted with Marconi AD6 apparatus and communicating with R.A.F. stations and a ½ kilowatt station at Rutbah Wells. During the flight from Basrah to Karachi, the machines will be in touch with two Marconi stations in Persia, at Chabar and Bunda Abbas The terminal wireless station at Karachi is one of the most powerful aerodrome stations installed at any air port, consisting of a 6-kilowatt Marconi transmitter with direction finder receiving apparatus. Many features of the Marconi apparatus for this service have been specially designed to meet the conditions existing on this new route.

AT the meeting of the Illuminating Engineering Society on Mar. 19 a paper on architectural lighting was read by Mr Waldo Maitland. The author defined this term as implying that the lighting becomes an essential part of the architectural scheme, and in some cases the major element Amongst the devices adopted, luminous panels in the ceiling and walls, lighted columns and lintels, and cornice lighting were mentioned, but in the examples shown by Mr. Maitland, which included a number of original lighting schemes adopted in Paris, many other novel methods were illustrated. This mode of lighting has been adopted at present mainly in the case of large stores, restaurants, and places of entertainment, but it has evident possibilities in modern buildings of architectural distinction Naturally these methods, which involve the reflection of light from diffusing surfaces (concealed lighting) or its transmission through more or less dense translucent glass, may require a higher consumption of energy than do conventional methods. But in many cases a sacrifice in efficiency might be tolerated in order to obtain the desired picturesque effect. Complete success, however, can only be obtained when the co-operation of the lighting expert and the architect can be secured in the early stages of the design of the building. At the conclusion of the meeting a series of demonstrations were given in the architectural lighting room of the E L.M.A. Lighting Service Bureau, various pleasing combinations of lighting from artificial skylights, cornices, luminous bands encircling the room, and luminous lintels and doorways being shown The underlying idea is based on the recognition that whereas the buildings of the past were designed solely with a view to appearance by daylight, appearance by artificial light is now

frequently of equal importance. This consideration may materially influence the architecture of the future.

Although little is now heard of Tutankhamen in the daily Press, the tomb continues to provide from its store a wealth of objects both of intrinsic beauty and of interest to the student of Egyptian culture. In the *Times* of Mar 30 is given a long list of articles from it which have recently been added to the Cairo Museum. Some of these are unique and many of unusual type Among these is the only existing example of the well-known sickle-sword known as 'Khepeth' with which the King slew his enemies A model sickle of wood inlaid with gold in the shape of the jaw-bone of an ass has red, blue, and purple glass in place of the more usual serrated edge of flint. Especially interesting are head-rests of an entirely new form. One is of blue faience with gold and polychrome glass, another of light blue glass, and a third is made like a three-legged stool with legs ending in goose feet and with a grotesque figure of the god Bes with its tongue out on top Boomerangs include some apparently of the returning Australian type and unlike the Egyptian throwing-stick type Another object which is unique is the King's game board. It is made of polished ebony marked off into 30 squares, of which some are marked with hieroglyphs. The pawns are of faience, and in a drawer in the board were two ivory knuckle bones and dice in the form of sticks, black on the one side and white on the other. Miniature boards of the same kind were also found. Of special interest to technologists were a wicker basket covered with linen on which were a design in yellow, blue, red, and white beads, and a pattern of beads representing captives on top, and a bow fire drill with which was a piece of wood bored with twelve holes and marked with charring, which had apparently been used with the drill for producing fire

A notable extension of the Manchester Museum is recorded in the *Report* for the year 1927–28. The Haworth Extension Building, which now becomes the centre and main entrance of the Museum as a whole, was erected at a cost of approximately £29,000, and £5000 has been spent upon cases and fittings The Haworth benefaction, a handsome gift, to which the extension was due, provides a further £1100 for additional cases, and a sum of £15,000 as a permanent endowment. Formally opened by Mrs Jesse Haworth on Nov. 28, 1927, the building has been devoted to the exhibition of ethnological collections in a series of alcoves, which serve to emphasise the geographical and racial human groups, while room has also been found for comparative series of weapons and utensils. Of the six floors of the building, the top and the basement, more than a third of the available area, have been allotted to work-rooms and the storage of study collections—a welcome indication that the needs of the student as well as of the ordinary museum visitor are being kept well in view. The removal of the ethnographical collections has permitted an expansion of the natural history collections, and the rearrangements thus made necessary are now in progress. It is an excellent sign of the place taken by the Museum in the education of the city that the Education Authority has delegated five teachers to conduct school classes in the galleries, to the extent of a hundred classes weekly, and the rearrangement of the collections will now enable these teachers to be provided with special rooms for their class-work.

The generally admitted superiority of American monthly journalism is challenged by a new monthly, entitled *The Realist*, the first number of which was published by Messrs. Macmillan and Co., Ltd., at the end of March. This journal is to be devoted to science, industry, art, and economics, and the general editor is Major Archibald Church An editorial board has been appointed, on which the interests of science are represented by such names as Prof. F G. Donnan, Sir Richard Gregory, Mr. J. B S Haldane, and Prof. Julian Huxley. The new magazine stands for scientific humanism, and we are invited editorially to test its scope by an examination of the subjects and writers of the articles published in this first issue. Literature is represented by Arnold Bennett, who writes on the progress of the novel, and by Aldous Huxley, who writes on Pascal. Among the subjects of articles of scientific interest are "Rejuvenation" by Norman Haire, "Science and the Farmer" by Sir Daniel Hall, "Scientific Humanism" by Dr. Charles Singer, and other articles deal with architecture, music, and the 'movies.' *The Realist* is excellently printed and produced, and if the high standard set by the first number is maintained the journal will soon secure wide recognition

The non-magnetic yacht *Carnegie* arrived at Papeete, Tahiti, on Mar. 13. Conditions throughout the passage from Callao, Peru, were excellent. On Feb. 16 the soundings obtained showed depths from 2700 metres to 5400 metres and back to 4100 metres over a distance of 50 miles; the ocean-deep thus revealed was named 'Bauer Deep.' Two uncharted submarine ridges were also discovered and rapid slopes off Tatakoto and Amanu Islands were determined On Mar. 8 five hours were spent ashore on Amanu Island The bottle-sample obtained at 2100 metres on Mar 10 (latitude 17°·6 south, longitude 141° 9 west) contained a few fragments of black lava with no trace of ooze, indicating recent volcanic origin The work done on this passage included 63 determinations of magnetic declination and 17 of magnetic intensity and inclination, 17 ocean-stations, at 15 of which bottom samples were obtained; 206 soundings, 35 pilot-balloon flights, one of which was followed to a height of more than 6 miles; 8 determinations of evaporation, 4 series of atmospheric-electric observations by eye-readings, each throughout 24 hours, and 23 complete 24-hour photographic electrograms of potential gradient. The vessel left Papeete on Mar. 20 for Apia, Western Samoa, she will also make a short stop at Pago Pago, American Samoa.

His Royal Highness the Prince of Wales has consented to become patron of the Society for the Preservation of the Fauna of the Empire, which was founded in 1903 by a group of animal lovers with the object of awakening public interest in the great heritage of wild life existing all over the British

Empire It has a very energetic president in the Earl of Onslow, and has helped in the formation of the many sanctuaries and national parks which are now to be found throughout the Empire. There is, however, much more work to be done in this direction, and the Society needs further support in order that it may continue to carry out its objects efficiently. The Society's secretary is Col. J. Stevenson-Hamilton, well known for his work in the formation of the Kruger National Park recently opened in South Africa. Further information about the Society can be obtained from the secretary, S P F.E , c/o Zoological Society, Regent's Park, London

His Royal Highness the Prince of Wales has consented to become an honorary member of the Linnean Society of London.

We much regret to announce the deaths of the Right Hon. Lord Avebury, on Mar. 26 at the age of seventy years, and of Lord Montagu of Beaulieu, K.C I.E., C.S.I., on Mar 30 at the age of sixty-two years. Lord Avebury was a trustee and also the honorary treasurer of the British Science Guild, and Lord Montagu was president of the Guild in 1920–22

Applications are invited for the following appointments, on or before the dates mentioned —A government chemist in Fiji—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S W 1 (April 10) A lecturer in metallurgy at the Technical College, Bradford — The Principal, Technical College, Bradford (April 12) An assistant lecturer in preparing, combing, and spinning and yarn manufacture at the Bradford Technical College —The Principal, Technical College, Bradford (April 12). An established analytical chemist, Class II , in the Royal Naval Cordite Factory, Holton Heath, of the Scientific Research and Experimental Department of the Admiralty — The Secretary to the Admiralty (C.E. Branch), Whitehall, S.W.1 (April 13). A fellowship in the department of Coal Gas and Fuel Industries of the University of Leeds for post-graduate research in gas chemistry—The Clerk to the Senate, The University, Leeds (April 19) A senior chemist under the Northern Coke Research Committee, Armstrong College—Prof. H V. A Briscoe, Armstrong College, Newcastle-upon-Tyne (April 22). A director of the Dental Prosthetic Laboratory, Guy's Hospital Dental School—The Dean, Guy's Hospital Dental School, London Bridge, S.E.1 (April 30). A professor of imperial economic relations, tenable at the London School of Economics—The Academic Registrar, University of London, South Kensington, S W 7 (April 30) A head of the Navigation Department of the L.C.C School of Engineering and Navigation, Poplar—The Education Officer (T 1a), County Hall, Westminster Bridge, S E 1 (May 13). A government analyst, Cyprus—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 An assistant editor of *Science Abstracts*—The Secretary, Institution of Electrical Engineers, Savoy Place, W.C 2.

Our Astronomical Column.

Studies of Proper Motion —Prof J Comas Sola, of Fabra Observatory, Barcelona, contributes an article on this subject to *Scientia* for March It begins with a historical review of the subject, and goes on to describe the modern methods of picking out stars with sensible motions by means of the stereocomparator This is essentially a stereoscope in which plates taken at an interval of a few years are viewed simultaneously by the two eyes. Prof. Sola has devised an improved form in which the plates can be rotated so that the displacement due to proper motion of the two images of any star is parallel to the line joining the eyes. He states that an interval of 20 days between the exposures suffices to give a sensible displacement in the case of 61 Cygni, the motion of which is 5·2″ per annum. The focal length of the camera employed is only 80 cm. He makes a comparison with the 'blink' micrometer, but considers his instrument superior Work of this kind is very useful for detecting faint stars with appreciable proper motion.

Wolf's Periodic Comet —Prof. M Kamiensky, Director of Warsaw Observatory, has been engaged for many years in a detailed study of the perturbations of this comet from the date of its discovery in 1884 to the present time. At the aphelion passage between 1918 and 1925, it approached very closely to Jupiter and suffered large perturbations that increased its perihelion distance from the sun by nearly a unit. These enormous perturbations were so accurately computed that the comet was found close to the predicted position

Acta Astronomica for January 1929 contains a careful recomputation by Prof. Kamiensky of the perturbations between 1891 and 1898 He had previously used A Thraen's results for this revolution, but finding that he did not use the latest values for the planetary masses, Prof Kamiensky has repeated the work with the greatest care, carrying the work to units of 0·001″. The differences from Thraen, after allowance has been made for the different masses employed, are very small. But it was necessary to repeat the work to obtain the degree of accuracy necessary to link together all the apparitions of the comet in a rigorous manner.

Clusters of Universes —It has been long known that there is a rich nebulous region in Virgo and Coma Berenices, close to the north pole of the galaxy. The nebulæ in this region are of the type which Dr. Hubble's researches marked out as external galaxies, so that we have evidence that these objects are not scattered uniformly but are aggregated more densely in some directions than in others In *Harvard Bulletin*, No 864, Prof. Harlow Shapley and Miss A. Ames show that, in addition to the main assemblage, the distance of which is given as about 10 million light years, there are three other adjacent 'clouds of galaxies', these are fainter and smaller, so are probably much more remote. The correlation between magnitude and angular diameter indicates the relation $m = 24 \cdot 15 - 5 \log d$, where m is the apparent magnitude and d the diameter in seconds. This equation would indicate the perfect transparency of space the departure from it is so small that it is estimated that the loss of light through absorption in space does not exceed one-fifth of a magnitude in a hundred million light years. This of course is not true in the special regions in our galaxy where there is strong evidence of local absorption by dark matter , as, for example, in the 'Coal Sacks.'

Research Items.

Witchcraft in Southern India.—In *Man* for March, Mr F. J. Richards publishes photographs of houses in Arantangi, Tanjore, which have been demolished by their owners in their fear of 'black magic.' On the occasion of a visit to the village in 1900 he found the Brahmins in a panic, stripping the thatch from the roofs of their houses and removing their belongings into the street. On the previous night no less than seven houses had been set on fire by supernatural agency, and the whole Brahmin quarter had been pelted with stones thrown by invisible hands. Stone-throwing continued in broad daylight, and when another fire broke out the householder brought to the author a rag ball a little bigger than a tennis ball which had been found under the eaves. Tow and rag had been rolled tightly together. It was damp and was said to smell of phosphorous, though this was not perceptible. In the centre was a small fruit stone—held by the villagers to be conclusive evidence of sorcery. The kitchens were desecrated with blobs of boiled rice, coloured yellow or magenta, and mixed with clippings of human hair and nail parings. These were found secreted in and about the cooking places. This defilement of places of which the ceremonial cleanliness is of the utmost importance, was especially to be noted. The Brahmin quarter was the residence of the most intelligent and prosperous section of the village. It was suggested that blackmail was the origin of the visitation. Some professed expert in sorcery had demanded a contribution from each household and had been refused. This was his retaliation.

A Pile-Dwelling at Brentford.—In *Antiquity* for March, Dr R. E. M. Wheeler describes some investigations recently carried out on the foreshore and in the bed of the Thames at Brentford. In 1928 public attention was attracted by the frequency with which bronze weapons and implements were found in the neighbourhood, and especially near the meadow "Old England" just above the junction of the Thames and the Brent, particularly through the collections made by Mr. G. F. I. Lawrence. Mr. O. G. S. Crawford has suggested that this may be the site of one of a number of settlements of lake-dwelling peoples from Switzerland of the late Hallstadt Iron Age. A fund was raised for excavation through the *Daily Express*. The result was the discovery of a Romano-British pile-dwelling—the first of the period recorded in the British Isles. As the excavations were below tide level, they were carried out under great difficulty and only part of the site was uncovered. This, however, was sufficient to indicate the existence of a rectangular dwelling. Piles were found in position with part of the floor of the hut. The first indication of the date of the structure was a complete Roman pot found above this floor. The structure of the floor was as follows: A pile was driven more than three feet into the gravel—how much more it is impossible to say; a horizontal beam was laid on the pile on the level of the gravel, then a layer of green clay was laid on the gravel to the height of the beam—6-7 inches. Upon this was laid a longitudinal layer of wattle. Upon this was a second horizontal timber and then a further layer of clay. A double layer of wattle formed the final floor, nearly 2 feet above the gravel. The timbers were unsquared. A Roman roofing tile beneath the wattle floor in the upper layer indicated the period. Roman pottery and roofing tiles were found around the hut. In the surface of the gravel, fragments of coarse pottery were found which can with confidence be assigned to the half millennium 1000–500 B.C., known in Central Europe as 'Hallstadt.'

Photosynthesis in the Sea.—The Annual Report for 1927–28, drawn up by the executive to the council of the Scottish Marine Biological Association, shows a satisfactory financial situation, the greater part of the expenses of the marine research being defrayed by the Development Fund of H.M. Treasury, together with an amount contributed from local sources. Miss S. Marshall and Mr. A. P. Orr having been granted leave of absence in order to join the Great Barrier Reef Expedition, temporary appointments have been made to fill their places. Before leaving, their researches on photosynthesis in the sea had been continued, including further experiments on diatom cultures enclosed in glass bottles suspended at different depths in the sea, the oxygen produced being measured. From the results it was concluded that the light intensity at which photosynthesis just balances respiration in these inshore waters is never deeper than 20-30 metres even in summer. As the surface is approached the increasing light enables more photosynthesis to take place, but this increase only goes up to a certain depth, above which the light is too strong. During the spring maximum the diatoms are so numerous that they shut off a considerable amount of light and the compensation point rises. Different species behave in different ways. The members of the genus *Chætoceros*, summer forms in these regions, were found to be more sensitive to sunshine than those of *Coscinodiscus*, which are chiefly spring forms, both in cultures and naturally in the sea. Two papers have been published by these authors in the *Journal of the Marine Biological Association* in 1927 and 1928, "The Relation of the Plankton to some Chemical and Physical Factors in the Clyde Sea Area" and "The Photosynthesis of Diatom-Cultures in the Sea."

Decapoda of the *Siboga* Expedition.—Dr. J. G. De Man has continued his studies of the rich material of the *Siboga* expedition, his latest report dealing with the Thalassinidæ and Callianassidæ (*Siboga* Expeditie. Monog. 39 a6, Leyden, December 1928). This report, which amounts to a partial monograph of the group, gains particular value from the list of species known in each genus and the tables for their identification. The *Siboga* material includes 10 species of *Upogebia*, of which 5 are new, and 15 of *Callianassa*, of which 12 are new. This large proportion of new species shows how little these burrowing forms are known. Dr. De Man illustrates this point by saying that, out of 76 species of *Callianassa* described, 46 have not been seen since their description. No one to this day knows the manner of life of *Jaxea nocturna*, which has been known since 1818. Its larva is commonly met with on the coasts of Britain, but the adult has been taken only twice. There is one omission from this report which is difficult to understand—*Naushonia crangonoides*. In one of his earlier reports, Dr. De Man includes it among the Crangonidæ, but he does not mention it here at all. There is no doubt whatever that it is not a crangonid but a thalassinid, and it is almost certain that it is closely related to *Jaxea*. The author does not enter into the question of the phylogeny and systematic position of these remarkable and probably very ancient Decapoda, but his extraordinarily detailed description of the species will be valuable material with which to build. The last word has certainly not been said as to the position of the Thalassinidea among the decapods or their relation to one another.

A Japanese Oligochæte.—Mr. Hironori Yoshizawa gives an interesting and detailed description of

the freshwater oligochæte *Stylaria lacustris* which is very common in the pond of the Biological Laboratory, Tôhoku Imperial University ("On the Aquatic Oligochæte *Stylaria lacustris* L." *Science Reports of the Tôhoku Imperial University*, 4th Series (Biology), Sendai, Japan, vol 3, No 4, Fasc 1, 1928). The worm is remarkable in having an elongated prostomium It was cultured in the laboratory, the cultured specimens being used for the present work. These all attained sexual maturity in early autumn, September and October being the natural time for the sexual form in the pond The food consists of diatoms, other algæ and vegetable debris One of its enemies is *Hydra*, which swallows the worm, helping it down with its tentacles (body length of the worm 8·11 mm). This reminds one of *Protohydra*, which can swallow oligochætes much longer than itself, and in that case with no tentacles at all Asexual forms are found in spring These are rather shorter and thinner than the sexual worms, and fission may take place in three or even in four places The front portion forms a new tail by adding a number of posterior segments, and the hind portion adds five new segments anteriorly to form a new head As a rule, fission proceeds from the ventral plane, midway between the anterior and posterior septa of the segment There are usually twenty-five segments, 16, 17, 18, 19, and 20 being the segments which most frequently undergo fission

LIVING FORAMINIFERA IN THE TRANSCASPIAN KARA-KUM.—Up to now only a few marine Foraminifera have been found in fresh waters or in continental waters generally. Some marine genera (such as *Polystomella, Rotalia*) come up to river estuaries and small freshwater lakes by the sea. In the spring of 1927, A. L Brodskii (*Priroda*, No. 11, 1928) found a numerous fauna of Foraminifera in the wells of the Kara-Kum desert These wells lie north-east of Askhabad, their depth is 18-20 m , temperature of the water in spring is 17°-20° C , and in some cases the water contains as much as 10 gm of salt per litre The Foraminifera found in the wells belong to the genera *Spiroculina* (a new species *turcomanica*), *Biloculina* (*B. elongata* and a new species *turcomanica*), *Textularia, Nodosaria*, and *Lagena*. They all contained protoplasm, and in some a nucleus or nuclei were found , thus there can be no doubt that they were alive. All the Kara-Kum Foraminifera are very small in size , whilst the marine *Spiroloculina* and *Biloculina* reach 2-3 mm in length, the Kara-Kum representatives of the genera scarcely exceed 0 16 mm. Their shells are fragile, transparent, flattened, and smoothed. They evidently inhabit salty ground-waters of the sands of Kara-Kum desert, whence they fall into the wells. They are probably relics of the Upper Tertiary seas which once covered the Kara-Kum desert. Waters of the Sarmatian and the Akchaghyl seas may also have stretched up to there It should be noted that *Polystomella, Rotalia, Textularia* are still found in the Caspian Sea. Masses of valves of *Polystomella* and *Discorbina* are found in the Aral Sea, and it is probable that Foraminifera live there now

REVISION OF THE GENUS *TRIGONELLA*.—In his monograph on the genus *Trigonella*, G. Sirjaev proposes a new division of the genus into three subgenera, fifteen sections and numerous subsections The first published part (*Publications de la Faculté des Sciences de l'Université Masaryk*, No 102, 1928) deals with the taxonomy and distribution of twenty-one species of the chief subgenus *Trigonella*, one new species from Bokhara and several new varieties being described.

WATER METABOLISM IN DUSTY LEAVES.—With most plants the transpiration of dust-covered leaves is considerably lower than that of leaves which have been recently cleaned, so that after a few hours the former leaves will contain appreciably more water than the latter An exception to this general rule, noted by Luigi Montemartini in the *Rendiconti* of the Royal Lombardy Scientific and Literary Institute (vol 61, parts 11-15), is observed in the case of *Ceratonia siliqua* (L) Here the cleansed leaves, although exhibiting a markedly more active transpiration, yet accumulate more water than those covered with a layer of road-dust To explain this exceptional behaviour, reference is made to the fact that, as Bose showed, transpiration renders more active the circulation and ascent of water in plants, whereas diminution of the transparency and of the permeability to gases of the cuticle by the thin coating of dust determines a decreased production of substances able to retain moisture in the cells It would seem that, with *Ceratonia* leaves, the cuticle presents peculiar features as regards this transparency and permeability and the cellular protoplasm a sensitiveness which, under the conditions employed, leads to a retardation of all the vital functions with consequent loss of water when the leaves are dust-covered.

CYTOLOGY OF *ŒNOTHERA*.—A useful summary of our knowledge of the cytology of *Œnothera* has been published by Prof R R Gates in *Bibliographia Genetica*, **9**, 401 (1928) It was in this genus that important correlations between chromosome content or behaviour and genetic phenomena were first discovered Since the original announcement of chromosome numbers in *Œnothera* was made in December 1906, an enormous amount of research has been carried out on many of the species, mutations, and hybrids of wild and cultivated evening primroses, as is indicated by the bibliography of seven and a half pages attached to this paper, which summarises work up to 1923, with some references to subsequent publications. Chromosome numbers in 30 species are now known The improvements in cytological technique in recent years have led to the demonstration of delicate connexions between the ends of the chromosomes, and these determine the peculiar alinement observed in the heterotypic metaphase. The meiotic process is certainly telosynaptic. The mutant *Œ. gigas* was the first investigated tetraploid mutation The first examples of non-disjunction were also studied in this genus, and double non-disjunction is now known to occur. Trisomic mutations, with 15 chromosomes, are the most characteristic of all the mutations of *Œnothera* and include the well-known *Œ lata, Œ scintillans, Œ. oblonga*, and *Œ albida* The view that *Œ. lamarckiana* is, in spite of the numerous mutations it has thrown, a persistent species of equal value to *Œ biennis* and others of the *Onagra* group, is maintained, though it is suggested that the whole group may be ultimately hybrid in origin. Indeed, it is accepted that hybridisation followed by new chromosome linkages and accompanied by mutations, some of them cytoplasmic and some arising in the chromatin, have been largely responsible for the evolution of the genus *Œnothera* as we now know it.

THE PARKGATE SEAM IN SOUTH YORKSHIRE.—The Department of Scientific and Industrial Research has issued the thirteenth of its physical and chemical surveys of the coal resources of Great Britain (London· H M.S.O., 1929), being an investigation of the Parkgate Seam, which occurs over an extensive area in South Yorkshire and the adjoining parts of Nottinghamshire and Derbyshire. The seam is an exceedingly

important one and extensively worked throughout the whole area in question. In Derbyshire and Nottinghamshire it is spoken of as the Deep Hard, whilst in Yorkshire to the north of Barnsley it is known as Old Hards. The seam is generally considered as capable of being divided into three main sections, namely, the tops, the hards or middle coal, and the bottoms. Of these, the middle coal may be considered the most important; it consists very largely of durain. The method of investigation in the present report has been to cut some sixteen samples from the Parkgate seam as it occurs in South Yorkshire in the exposed portion of the coalfield, ranging from a little north of Barnsley to just south of Sheffield. These samples have then been fully examined, and the results of the examination are reported in detail; the determinations include approximate analysis, ultimate analysis, calorific value, melting point of ash, carbonisation assay, and ultimate and proximate analyses of the four constituents, vitrain, clarain, durain, and fusain. The work has been done not only on the whole sample, but also upon the various sections into which each sample could be divided, the sample consisting in every case of a vertical prism of the coal cut from the roof to the floor. When, as is sometimes the case, a certain portion of the top coal is left standing to form a roof, such portion has not been included in the sample. The report gives evidence of very thorough and careful investigation, and the results should be of value to those engaged in working this particular seam, that is to say, to practically all the collieries working in the area above indicated.

A NEW WARM STAGE.—An electrically heated warm stage and compressor for use with high-power objectives is described by Messrs. J. E. Barnard and F. V. Welch in the January issue of the *Journal of the Royal Microscopical Society*. The apparatus consists of a small box which encloses the heating system, the microscope stage and object holder, and also the objective and substage illuminator. The box is in two parts, one of which slides off the other and permits access to the object without disturbing the microscope or its adjustments. The two electrical heating elements are clamped on the under-side of the stage, one on each side of the condenser, and the leads to them connected to the mains in series with a suitable variable resistance. The temperature of the air inside the box is raised, and the stage and compressor can therefore be maintained at a constant temperature. As the compressor is a relatively large mass of metal, its temperature once raised changes little, and hence the two cover-glasses between which the material is placed for observation are also maintained at a constant temperature. The apparatus was designed for use in an investigation on bacteriophagic action involving observations of living bacteria for long periods, and for this purpose has proved entirely satisfactory.

ULTRA-VIOLET LIGHT TRANSMITTING GLASSES.—An interesting paper by Starkie and Turner on the composition and properties of ultra-violet light transmitting glasses has appeared in the *Journal of the Society of Glass Technology*, vol. 12, No. 48. An account of the development of these glasses is given, together with some analyses. The limits of transmission in the ultra-violet and the percentage transmission have been studied for eight commercial ultra-violet glasses, and the results show a wide divergence for the different samples. The ageing effect of sunlight, known as solarisation, was examined, and an exposure of several months in summer was found to reduce the transmission by more than 10 per cent in some cases. Exposure to the light of a powerful arc for several hours brought about much more rapid ageing. This ageing is usually accompanied by a colour change from a greenish to a brownish tint, which supports the theory of Starkie and Turner, that the dominating factor in solarisation is the conversion of ferrous to ferric oxide in the glass.

THE MECHANISM OF ARCS.—It seems now to be generally agreed that it is not necessary for the cathode of an arc to be hot for the discharge to pass. The problem therefore arises as to how the current is maintained, if it is not primarily due to thermions from the metal, and to meet this difficulty the suggestion has been made by Prof. Seeliger and by Dr. Langmuir that there is an 'autoelectronic' liberation of electrons from the surface of the cathode in the high electric fields that are present in the localised region of the cathode fall in potential. These fields can be of the order of a million volts per centimetre, and are ample to pull electrons out of a cold metal under appropriate conditions, such as those employed, for example, in the recently revived Lilienfeld type of X-ray bulbs. Unfortunately, this theory requires that the current density in the cathode spot should not fall below about 1000 amperes per sq. cm., whereas some arcs in gases at reduced pressure have been described by J. Slepian and E. J. Haverstick in the January issue of the *Physical Review* in which the current density was only about one per cent of this. It appears, then, that the field theory is not tenable, if its interpretation by these authors is correct, and they have again directed attention in the same paper to a theory proposed by one of them (J. Slepian) three years ago, which referred the maintenance of the arc not to any emission of electrons from the cathode at all, but to the thermal ionisation of a layer of gas in its immediate vicinity.

RAMAN OPTICAL EFFECT.—In spite of the attention that the quantised scattering of light discovered by Prof. Raman has already received, there are a number of points connected with it that are still obscure. Perhaps the most significant of these is the difference in intensity between the Raman satellites and the corresponding infra-red absorption bands and maxima of selective reflection. Quartz, for example, gives rise to Raman satellites equivalent to natural vibrations at 38 μ, 48 μ, and 78 μ, all of which were, until recently, unknown in the infra-red spectra. M. Czerny has now recorded the pair at 38 μ and 78 μ as absorption bands of crystalline quartz, using a grating apparatus (*Zeitschrift fur Physik*, Feb. 19); he has, however, found not the slightest trace of a band at 48 μ in this way, although there is an intense Raman satellite corresponding to this wave-length. The origin of these discrepancies can only be surmised at present, but it may be, as the author suggests, that they arise from the fact that for a body to show the phenomena of selective reflection and absorption, the oscillators in it must have other properties than the mere possession of a definite period, whereas possibly the last condition alone suffices to produce a Raman satellite in scattered light.

DETERMINATION OF TRACES OF IODINE IN VEGETABLES.—McClendon and Remington, in the February number of the *Journal of the American Chemical Society*, describe a method for the estimation of small quantities of iodine in vegetables, depending on combustion in oxygen, the material being fed into a silica combustion tube by a special arrangement so as to avoid soot and tar formation. Chlorides and iodides volatilise and are condensed by electrostatic precipitation. Low temperature burning in open dishes requires about fifteen hours for 100 grams of dry sample, and does not lead to large losses of iodides if the ash is alkaline and the temperature never exceeds 450°. Calcium lactate must be added to vegetables with an acid ash (cereals) in order to make the ash alkaline and to prevent its fusion. Combustion is never complete if the ash fuses.

Weather and Wireless

MR R A WATSON WATT delivered the G. J. Symons Memorial Lecture of the Royal Meteorological Society in the rooms of the Society on Mar. 20 The lecture was illustrated by the first public demonstration, in Great Britain, of the reception by wireless picture telegraphy of current weather charts and forecasts, and also by the first public demonstration of the cathode ray direction finder. Figs. 1 and 2 are reproductions of the synoptic chart for 6 P M on the evening of the lecture and of a general inference and forecast based on the same data which were prepared in the Meteorological Office at the Royal Airship Works, Cardington, transmitted by the Fultograph method from the wireless station at Royal Airship Works, and received by wireless in the rooms of the Society before 8.15 P.M The reproductions are from photographs of the actual Fultograms received by wireless.

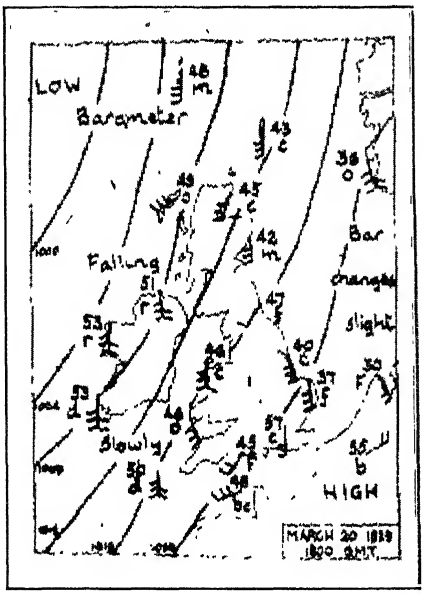


FIG 1 —Synoptic chart transmitted and received by wireless on Mar 20 by the Fultograph method

Subjoined is a summary of Mr Watson Watt's lecture

WIRELESS AND WEATHER WARNINGS.

Wireless communication is of vital service to the forecaster, particularly in Great Britain, because of five special facts affecting synoptic meteorology, namely, that:

(1) Data from very wide areas must be utilised in the preparation of forecasts

(2) British weather comes mainly from the west.

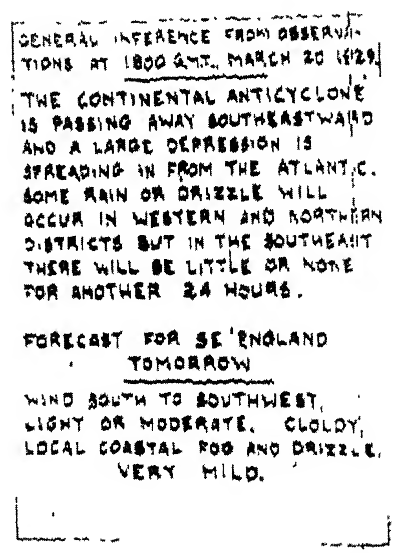
(3) The shortness of the periods for which we can at present forecast makes it imperative that the exchange of data should be extremely rapid

(4) The importance, in navigation, of meteorological data more recent than that available at the time of departure increases rapidly with the mobility, speed, and range of action of the craft concerned

(5) Aircraft require the most detailed meteorological information attainable, on account of the extreme seriousness of the results of meteorological interference with normal flying

The present state of organisation is such that the data for the whole of Great Britain is collected within an hour, sufficient data for Europe as a whole within an hour and a half, while a chart containing data for the whole northern hemisphere at 7 A M is issued before noon. Data from the Atlantic shipping routes is of special importance to the British forecaster, and transmission by wireless alone can put it in his hands sufficiently quickly

The broadcasting of weather reports and forecasts is forming a public opinion which will react beneficially on the science by increasing the attention paid to meteorology in education The broadcasting of synoptic charts by picture telegraphy will enhance the value and facilitate the interpretation of the


GENERAL INFERENCE FROM OBSERVATIONS AT 1800 GMT., MARCH 20 1929.

THE CONTINENTAL ANTICYCLONE IS PASSING AWAY SOUTHEASTWARD AND A LARGE DEPRESSION IS SPREADING IN FROM THE ATLANTIC. SOME RAIN OR DRIZZLE WILL OCCUR IN WESTERN AND NORTHERN DISTRICTS BUT IN THE SOUTHEAST THERE WILL BE LITTLE OR NONE FOR ANOTHER 24 HOURS.

FORECAST FOR SE ENGLAND TOMORROW

WIND SOUTH TO SOUTHWEST, LIGHT OR MODERATE. CLOUDY, LOCAL COASTAL FOG AND DRIZZLE. VERY MILD.

FIG 2 —Written weather forecast transmitted and received by wireless on Mar 20 by the Fultograph method

broadcast reports. An experimental period of transmission of current synoptic charts will begin at a very early date, the transmissions being made from Daventry on the Fultograph system Such transmission of charts by one of the wireless methods now available is likely to be of extreme value to the airship navigator, who must be put in possession of sufficient data for the intelligent application of the forecasts sent him. The demonstration given showed the transmission and reception of current weather charts and written forecasts, and in particular the reception by wireless picture telegraphy of a synoptic chart for

6 P.M. of the same evening, together with a written forecast, prepared in the Meteorological Office at the Royal Airship Works, Cardington, and transmitted by wireless from Cardington.

The Weather of Wireless.

Wireless has a climate and a weather of its own. The weakening of signals over different kinds of country, depending on time of day and season, the dependence of atmospherics on latitude, place, and time, are climatological in scope. The quick-period variations, erratic fading phenomena, and the like, are of the nature of weather, and atmospherics are the rainfall of wireless. The history of civilisation is in the main the story of man's progress towards independence of the weather. The history of wireless telegraphy is that of progress in the mitigation of these disturbing factors.

The study of fading and signal variations is simplified by considering separately the energy which travels along the earth's surface and the energy which, after reaching high levels in the atmosphere, is returned to the ground level by reflection or mirage effects occurring at heights of 50 to 150 miles. The ground ray is heavily absorbed, but is not subject to random variations. It can therefore be depended upon to give a reliable 'service area' of limited extent around the transmitter. Outside this area the ray returned from the upper levels (the 'sky wave' as it is called in America) may arrive in such a relation to the ground ray as to neutralise it, and leave no signal at all, while a slight change in the conditions aloft will cause reinforcement. This gives a zone of severe fading outside the service area. Still farther out the ground ray is so weak that it can never wipe out the sky wave, and so fading is actually less severe than nearer the transmitter. The limited range of the ground ray means that the greater part of the world's wireless communications is carried by the sky wave. It is as if stations which are out of range for direct vision communicated by lighting up a cloud layer the illumination of which is then visible at the distant receiver. Most of the foreign broadcasting stations heard at night on the average broadcast receiver in Great Britian are heard by this process.

Increasing sunspot activity improves the wireless mirror formed by the upper layers, and so improves long-wave reception. But for short waves these layers act as a cloudy prism rather than as a dirty mirror, and increased solar activity makes the layers absorb short waves more strongly, so impairing short-wave wireless.

Means have been developed for measuring the heights at which the turning back takes place, and the use of different wave-lengths in these measurements should provide valuable data as to the constitution and properties of the atmosphere at great heights.

Conditions for the travel of short waves in the upper air are often so favourable that a signal is received directly, and again after it has been once or several times round the world. Moreover, it would appear that 'echoes' of this kind have been received owing to waves penetrating the upper layers, and being sent back from a reflecting surface, far beyond the moon's orbit, formed of electrons which have been emitted from the sun.

Atmospherics, of which as many as three or four thousand per second can be counted in a tropical night, are found to be capable of disturbing broadcast reception at stations up to four thousand miles from the place at which they originated. The average atmospheric applies to the receiving aerial an electric force a hundred thousand times as great as is needed to give a readable signal.

The Effect of Weather on Wireless

Atmospherics are found to originate in thunderstorms, and the predominant source of the world's supply of atmospherics at any given hour lies in a land where it is summer afternoon. The strength of atmospherics radiated from thunderstorms at known distances agrees with that computed from other data about lightning, and the average atmospheric received in England is of such strength as would be radiated from a lightning flash 2000 miles away. By means of visual direction finders, of the type demonstrated in operation, thunderstorms can be located by observations at stations one or two thousand miles away.

The surfaces of discontinuity between cold and warm air masses, which form the principal features in the modern interpretation of the weather map, produce marked modifications in the strength of signals in the path of which they lie. These discontinuities also produce errors in directional observations.

The Effect of Wireless on Weather

Dr. Johnson has immortalised a brief chapter "Concerning Snakes," the full text of which is "There are no snakes to be met with throughout the whole island." Thus it is with the frequently alleged effects of broadcasting on the weather.

It is to be remembered that all the rainfall of the world must be produced by evaporation, and that the average rainfall of England requires for its evaporation the expenditure of energy at the rate of a third of a million horse-power per square mile, night and day, *throughout the year. This is the approximate* power of the Barking super-power station, the largest electricity generating station in Great Britain. The total rate of emission of energy from all the broadcasting stations of Great Britain and Northern Ireland, in the limited periods during which they are working, is less than 55 horse-power, the corresponding figure for Europe being about 400 horse-power. Any effect of broadcasting on rainfall would, therefore, mean the exercise of control by the expenditure of energy amounting to less than one part in a thousand million, a reaction so sensitive that it could not have escaped detection in the laboratory. The scale may be represented in another way by remarking that the annual rainfall for a single tennis court, if the energy required for evaporation were purchased at a favourable rate as electrical energy, would cost about £800, while the London listener pays only $\frac{1}{8}d.$ per annum, in his 10*s.* licence fee, for transmitter power. The expenditure on transmitter power for all the B.B.C. stations amounts to only $\frac{3}{4}d.$ per licence.

Wireless and Weather Warnings.

Extensions of the application of wireless telegraphy in meteorological communications may well include the transmission of three-colour charts, in which the fronts are indicated in distinctive colours. The detection and location of thunderstorms by wireless direction finding on atmospherics has been tested, and further experimental work is likely to lead to applications of this method in the meteorology of air-routes. It is possible that some of the other measurements of the effects of weather on wireless, as described, may be of use as aids to the forecaster in the identification and location of fronts. It may also be possible to trace a relation between measured ionisation gradients at considerable heights and the convective processes in the troposphere.

The Stereochemistry of Tellurium.

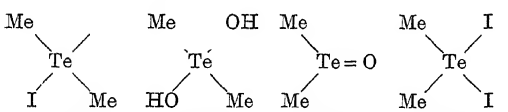
By Prof. T. M. LOWRY, F.R.S.

NEARLY ten years ago the late Mr R H. Vernon made a remarkable series of observations on the occurrence of isomerism in the alkyl derivatives of tellurium[1] The initial compound can be prepared by the direct action of metallic tellurium on methyl iodide, $Te + 2CH_3I \longrightarrow Te(CH_3)_2I_2$. Silver oxide then liberates from the iodide a weak 'α' base, $TeMe_2(OH)_2$, which when dehydrated undergoes a molecular re-arrangement, and is converted into a rather stronger 'β' base From this 'β' base a series of 'β' salts can be obtained, which have the same composition as the 'α' salts derived from the 'α' base. Measurements of boiling-points of solutions in acetone, and of freezing-points of solutions in benzene and in nitrobenzene, indicated that the two chlorides had the same normal molecular weight, but that, whilst the α-dibromide and the α-di-iodide were also normal, the β-compounds were partially polymerised thus :

MOLECULAR WEIGHTS

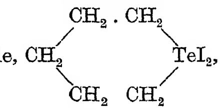
	α (Obs.)	β (Obs.)			Calc
Chlorides in acetone	229	226	230	223	228
Bromides in acetone	335	430	459	525	317
Bromides in nitrobenzene		400	445	370	
Iodide in benzene	401				411
Iodide in acetone		509	707		

In view of the equality of molecular weights of the chlorides, and of the methods by which the α and β salts were produced, Vernon supposed that they represented the *trans* and *cis* forms of molecules having a square configuration, like that which Werner assigned in 1893 to the isomeric platinous compounds of the type $Pt(NH_3)_2Cl_2$, thus ·



α-Di-iodide (*trans*) α-Base (*trans*) Anhydrous β-Base β-Di-iodide (*cis*)

The thorough character of the work, the simplicity of the explanation, and the obvious analogy with platinum, won for this scheme an immediate and universal acceptance, and it was a source of pleasure to me, in view of my intimate association with Vernon's earlier activities, to be able to record in December last[2] the fulfilment of Vernon's prediction in reference to the diethyl base that "If this base does not decompose when its solution is evaporated to dryness, but gives diethyltelluronium oxide, the existence of two haloid series would be highly probable" A detailed physico-chemical study with Mr Gilbert[3] of Vernon's own compounds had also confirmed the equality of molecular weights of the α- and β-compounds, since measurements of the freezing-points of aqueous solutions gave almost identical values for van 't Hoff's i-factor, namely, 1 1 for the α- and β-bases, and about 1 8 for the α- and β-hydroxychlorides $TeMe_2(OH)Cl$

Although, however, Vernon's experiments were impregnable, and the evidence for identity of molecular weight appeared to be ample, the writer concluded[4] that "The striking difference in colour of the α- and β-dihalides shows that the isomerism of the α- and β-compounds must include some factor which is not expressed completely by merely putting two halogen atoms and two alkyl radicals at adjacent or at opposite corners of a square" Serious reasons for doubting the validity of the whole scheme were found for the first time, however, when further experiments showed[5] that a *cyclo*-telluropentane di-iodide,  prepared by Morgan, and Burgess,[6] and the bases and salts derived from it, behaved in five different points like the corresponding α-compounds of Vernon's series, to which he had assigned a *trans*-configuration. Examination of models showed that, whilst it was easy to form a strainless ring in the case of a *cis*-compound, the formation of a *trans*-ring involved as usual an intolerable strain, which produced a corresponding strain on the theory and made it desirable to look round for possible alternatives An analysis of the facts which were then available, showed that a larger number of them could be covered by assigning to quadrivalent tellurium a tetrahedral instead of a planar configuration,[7] but, in order to explain the formation of α- and β-isomerides, it was necessary to distort the regular tetrahedron, which is accepted universally in the case of sulphur, by making one valency different from the other three

A new series of experiments, described by Dr. H D. K Drew before the Chemical Society on Jan 17 (*Jour. Chem. Soc*, p 560, 1929), has removed the last obstacle to a complete analogy between sulphur and tellurium, by showing that the changes recorded by Vernon involve an alteration of structure which goes beyond the limits of stereoisomerism This change of structure was actually observed by Vernon, who showed, while the α-di-iodide and potassium carbonate gave a basic salt,

$$2\ \alpha\text{-}TeMe_2I_2 + K_2CO_3 \longrightarrow I\ .\ TeMe_2\ .\ O\ .\ TeMe_2\ .\ I + 2KI + CO_2,$$

the β-di-iodide and potassium carbonate gave trimethyltelluronium iododide, by the wandering of a methyl group,

$$2\ \beta\text{-}TeMe_2I_2 \longrightarrow TeMe_3I + \quad ?$$

Vernon supposed that this wandering took place under the influence of the alkali, but Drew's experiments show that it had already taken place in the preparation of the β-base, since the β-di-iodide is itself a complex salt, which can be synthesised readily from the *mono-* and *tri*-methyltelluronium iodides,

$$TeMe_3I + TeMeI_3 \longrightarrow TeMe_3I,\ TeMeI_3 \text{ or } [TeMe_3]^+ [TeMeI_4]^-.$$

The structure of these compounds was confirmed by a corresponding synthesis of the "β-dibromide" $TeMe_3Br$, $TeMeBr_3$, and of mixed halides of the composition $TeMe_3Br$, $TeMeI_3$ and $TeMe_3I$, $TeMeBr_3$

The simple salts from which the more complex β-compounds were synthesised are obviously derivatives of trimethyltelluronium hydroxide, $TeMe_3OH$, and of the monomethyl compound Me . TeO . OH, which Drew describes as telluracetic acid. He there-

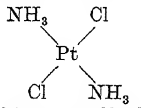
[1] *J Chem Soc*, **117**, 86, 889, 1920 **119**, 105, 687, 1921
[2] F L Gilbert and T M Lowry, *J Chem Soc*, pp 3179-3189, 1928
[3] *J Chem Soc*, 1997-2010, 1928
[4] *J Chem Soc*, p 308, 1928
[5] Gilbert and Lowry, *J Chem Soc*, 2658-2667, 1928
[6] *J Chem Soc*, 321-329, 1928
[7] *Chem and Ind*, **47**, 1246, Nov 23, 1928

fore assigned to the β-base the structure of an *anhydride*, $TeMe_3O . TeMeO$. Since, however, the monomethyl compound can be shown to have an acid rather than a basic reaction,[8] it is clear that the mixture of *mono-* and *tri*-methyl-hydroxides should form a *salt* $[TeMe_3]^+ [Me\ TeO\ \bar{O}]$ The correctness of this alternative view can be established from measurements of conductivity,[8] which show that the 'β-base' gives a curious series of values ranging from $\Lambda^{25}_{32} = 31$ to $\Lambda^{25}_{512} = 37$. These can be explained by assigning to the cation $[TeMe_3]^+$ a mobility of 50, as in the case of $[NMe_4]^+$, and to the anion $CH_3\ TeO . \bar{O}$ a mobility of 30, as in the case of the acetate ion $CH_3 . CO\ \bar{O}$, giving a limiting conductivity of 80 for the salt, or 40 for each atom of tellurium, in close agreement with the data recorded above

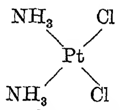
It is important to point out that whilst the *stereoisomerism* of Vernon's theory has been disproved, the *isomerism* indicated by his experiments may still be valid for some of the compounds of this series In particular, crystallographic evidence suggests that the α-di-iodide is itself a complex compound, with a structure that is very similar to that of the β-di-iodide, there are therefore clear indications that the α-dihalides may form complex molecules of the type $[TeMe_2I]^+ [TeMe_2I_3]^-$ which would be isomeric with $[TeMe_3]^+ [TeMeI_4]^-$, although they are evidently more readily dissociated into molecules or ions containing only a single atom of tellurium.

The abrupt disappearance of the only evidence which justified the representation of quadrivalent tellurium by a planar model at once raises the question whether the analogous configurations for quadrivalent platinum and palladium are likely to survive In a matter of this kind, prediction is dangerous, but it can at least be said that the planar formulæ for palladium and platinum are supported by a greater variety of evidence and are therefore much less likely to collapse under a single blow The evidence cited by Werner in 1893 [9] corresponds closely with that obtained by Vernon So long ago as 1828, Magnus,[10] by the action of ammonia on platinous chloride, obtained a compound which is still known as *Magnus' green salt.* This has the empirical composition $PtCl_2 . 2NH_3$, but behaves as a complex salt of the formula, $[Pt . 4NH_3]^{++} PtCl_4^{--}$ When boiled with ammonia it is converted into *Reiset's salt*,[3] $[Pt . 4NH_3]^{++}Cl_2^{--}$, which on heating to 250° [11], or on boiling with concentrated hydrochloric acid,[12] is converted into two isomeric forms of the non-valent diammine $[2NH_3\ PtCl_2]$ These two isomers, which can be prepared more readily by the action of ammonia on ammonium platino-chloride,[13] $(NH_4)_2PtCl_4$, are distinguished, for no very obvious reason, as platosammine chloride and platosemidiammine chloride

The two compounds, which differ in colour and in solubility, were formulated somewhat arbitrarily by Werner [14] as follows :



Platosammine chloride (sulphur-yellow), β or *trans*



Platosemidiammine chloride (orange-yellow), α or *cis*

On account of their limited solubility, their molecular weights were not determined precisely until 1926, when Reihlen and Nestle [15] made a series of observations on the vapour pressures of solutions in liquid ammonia These showed that the *cis* compound had a normal molecular weight, whilst that of the *trans*-compound was twice as great On the other hand, Grunberg [16] has obtained normal values for solutions in acetone of both forms of the thiocyanate, $[2NH_3\ Pt(CNS)_2]$, Hantzsch [17] has obtained normal molecular weights for solutions in phenol of both forms of the dipyridyl-compound $[2C_5H_5N, PtCl_2]$, and Kraus and Brodkorb [18] have obtained normal values for the two forms of $[2C_5H_5N . PdCl_2]$ and $[2EtNH_2 . PdCl_2]$, as well as for one form of $[2NH_3 . PdCl_2]$, the other being hydrolysed too readily to permit of accurate measurements

Up to this point the story is an almost exact duplicate of the recent observations on tellurium, since the mere multiplication of examples of α- and β-compounds does not rule out the possibility of an alternative explanation of the supposed isomerism in either case, and the repeated determinations of molecular weights have again provided conflicting evidence. It is also open to question whether the occurrence of the same isomerism in tetrammines of the type $[2C_5H_5N . Pt\ 2NH_3]Cl_2$, might not stand or fall with that of the diammines Fortunately, however, physical evidence is now available which appears to be decisive on the point at issue Thus crystallographic observations have shown that the double cyanides, $K_2[Zn\ 4CN]$, $K_2[Cd . 4CN]$, $K_2[Hg\ 4CN]$, crystallise in the *cubic* system, and X-ray analysis [19] confirms the obvious deduction that the anion has a tetrahedral configuration, such as has already been found in the molecules of $[SnI_4]$, although the ion $[SnCl_6]^{--}$ has an octahedral configuration On the other hand, the two pallado chlorides, $K_2[PdCl_4]$ and $Am_2[PdCl_4]$, and the platinochloride $K_2[PtCl_4]$ all crystallise in the *tetragonal* system, and X-ray analysis [20] confirms the deduction that the anion has the same symmetry as the crystal and must be represented with the four halogens at the corner of a square of which the metal occupies the centre The planar configuration which Werner assigned to this group of compounds thirty-five years ago is therefore now established by a process of mensuration, which does not encourage any hope of its disestablishment by less direct chemical methods.

[8] Gilbert and Lowry *J Chem Soc*, 1997-2010 ; 1928
[9] Werner, *Zeit anorg Chem*, **3**, 310, 1893.
[10] Magnus, *Pogg Ann*, **14**, 204, 1828
[11] Reiset, *Compt rend*, **10**, 870, 1840 **11**, 711, *Ann Chim Ph* [3] **11**, 417, 1844
[12] Peyrone, *Ann Chim Ph* [3] **12**, 193 ; 1844 **16**, 462, 1846
[13] Jorgensen, *Zeit anorg Chem*, **24**, 181, 1900
[14] Werner, *Zeit anorg Chem*, **3**, 310, 1893

[15] Reihlen and Nestle, *Ann*, **447**, 211, 1926
[16] Grunberg, *Zeit anorg Chem*, **157**, 299, 1926
[17] Hantzsch, *Ber*, **59**, 2761, 1926
[18] Kraus and Brodkorb, *Zeit anorg Chem*, **165**, 73, 1927
[19] Dickinson, *J Amer Chem Soc*, **44**, 774, 1922
[20] Dickinson, *J Amer Chem Soc*, **44**, 2404, 1922

University and Educational Intelligence.

LONDON —Dr Harold Raistrick has been appointed as from Aug 1 to the University chair of biochemistry tenable at the London School of Hygiene and Tropical Medicine, where he will also hold the position of Director of the Division of Biochemistry and Chemistry as applied to Hygiene Dr Raistrick is a graduate of Leeds and Cambridge. From 1915 until 1920 he was engaged on research work on the biochemistry of micro-organisms for the Medical Research Committee in Sir Frederick Hopkins's laboratory at Cambridge, and since 1921 he has been on the research staff of Messrs. Nobel's Explosives Company, Ayrshire, where he organised and equipped a new Biochemical Research Department

THE National Union of Teachers held its annual conference this year at Llandudno on Mar 30. The

presidential address, delivered by Mr C. W Cowen, of Sheffield, emphasised the increasing, and increasingly necessary, solidarity of the teaching profession and the broadening of the basis of the Union since 1888 when the word 'elementary' was eliminated from its title Referring to the Board of Education's pamphlet on "The New Prospect in Education" and the reorganisations designed to provide advanced instruction for all pupils of secondary school age, the president, while regretting that it has not been decided to enforce throughout England the raising of the age-limit of compulsory attendance, pointed out that such reorganisations involve risks of hardship in individual cases and appealed to the Board that local education authorities should not be compelled to proceed immediately with far-reaching schemes but invited to put them into operation cautiously and by stages as vacancies arise through retirement or other causes. Turning to the relationship between education and industry, and to the gap left by the decay of the apprenticeship system, he expressed the opinion that as an effective training must be based upon an adequate general education, the raising of the school leaving age to at least fifteen years is an essential preliminary to advance He lamented the destruction, attributed to the opposition of small-scale employers, of the powerful movement towards day continuation schools He closed with an appeal to teachers to take an even greater part than they do already in all social movements which tend to the uplift of the masses of England.

FROM the Universities Bureau of the British Empire we have received a pamphlet (pp 36, price 1s) containing lists of students from other countries in the universities and university colleges of Great Britain and Ireland in the current session The names of the students are grouped, separately for each institution, under the names of the countries to which they belong, and there is a table showing the total number of students from each of the countries named The grand total of these numbers is 5170 The countries contributing most to this total are India and Burma 1575, South Africa and Rhodesia 574, United States of America 556, Egypt 382, Australia and New Zealand 336, Canada and Newfoundland 203, Germany 157, West Indies 128, Ceylon 121, China 93 Of the Indian students more than half are in the London colleges, and of the remainder Oxford and Cambridge have 181, the modern English provincial universities 288, Edinburgh 133, and Glasgow 99 Of the 574 South Africans, 222 are in the London colleges (123 in the medical schools), 163 at Oxford and Cambridge, 100 at Edinburgh. Oxford has 168 students from the United States, including 96 Rhodes Scholars, Cambridge 64, London 136, and Edinburgh 127 The Egyptian students are chiefly in the modern English provincial universities (162), especially Birmingham (55), in London (131), and also in Edinburgh (55). Australians and New Zealanders congregate chiefly in Oxford and Cambridge (157), London medical schools (64), and Edinburgh (37); Canadians in the London colleges (77), Oxford and Cambridge (74), and Edinburgh (35). German students have been coming to England in rapidly increasing numbers in the past four years: they are chiefly in London (94), especially the School of Economics (40), and the modern English provincial universities A comparison with similar pamphlets published two years and four years ago discloses some interesting increases. grand totals—4385, 4596, 5170, India, Burma, and Ceylon, 1199, 1361, 1696; Germany, 34, 93, 157; and decreases—South Africa, 747, 624, 574, Siam, 79, 62, 37.

Calendar of Patent Records.

April 6, 1852—It was Samuel Fox who introduced the light steel frame for umbrellas and parasols His patent for constructing the ribs and stretchers of steel formed into hollow trough-like shapes was granted on April 6, 1852, and the frames were put on the market under the well-known 'paragon' mark

April 9, 1788.—The first beater thrashing-machine was patented on April 9, 1788, by Andrew Meikle, who was led to the invention by making experiments with a machine of a different type which did not work satisfactorily. John Rastrick, the engineer, was also trying to solve the problem at the same time, and says himself that he had made machines on Meikle's plan about ten years before the date of the patent, but though there is evidence that Meikle's rights were contested and that he obtained little benefit from his patent, nothing has so far come to light to support Rastrick's claim to be the real inventor

April 10, 1790—The first federal Patents Act of the United States was passed on April 10, 1790, and the first grant under it was made to Samuel Hopkins in the following July. Many patents had, however, been issued previously; by extension of English patents by the Crown to include one or more of the colonies, directly by the colonial authorities, and, after the Declaration of Independence, by Acts of the various State legislatures, especially Maryland, Connecticut, Massachusetts, and Pennsylvania

April 10, 1811—In the first days of the railway locomotive, it was widely held—in spite of evidence to the contrary—that the adhesion of smooth wheels on the rails would not be sufficient to enable heavy loads to be drawn along the railway, and Blenkinsop's rack locomotive was designed to overcome this objection This was patented on April 10, 1811, and was introduced on the tramline of Middleton colliery, near Leeds.

April 11, 1807—The modern method of igniting the powder charge in all fire-arms dates from the invention of the percussion lock by the Rev. Alexander John Forsyth, the patent for which is dated April 11, 1807 Forsyth used as his detonating powder a mixture of potassium chlorate, sulphur, and charcoal, but the specification is drawn in wide terms to include all percussion systems, and the patent was held to be good after a strenuous fight in the courts The British government was, however, slow to adopt the new method, and Forsyth received no benefit from his patent, though his heirs were afterwards given a government grant of £1000.

April 13, 1847—Theodore Boehm's improvements in the flute, which consisted mainly in the provision of a cylindrical instead of a tapering bore, and the adoption of a system of rings and levers in combination with the keys, whereby the fingers were given much easier control, received a Bavarian patent for five years on April 13, 1847. The introduction of the new flute raised a great controversy both as to the merits of the new construction and to Boehm's claims to be the inventor, but its use soon became general

April 13, 1869.—George Westinghouse's first patent for a continuous air-brake for railway trains was granted in the United States on April 13, 1869 The idea did not originate with Westinghouse, but his construction embodying the three-way control cock and automatic valves in the connecting tubes, which ensured that the system would still continue to work if part of the train became disconnected, was the first practical system, and was immediately taken up. It was greatly improved in the following years, and by 1874 had been fitted to more than 2000 locomotives and 7000 coaches

Societies and Academies.

London.

Society of Public Analysts, Mar 6.—Christine Mary Fear. On the alkaloid test for tannin. It has frequently been asserted that most alkaloids are precipitated by tannin, but the author's experiments show that the only alkaloids giving appreciable precipitates with tannin solutions alone are brucine, caffeine, cinchonine, cinchonidine, quinine, and strychnine —A L. Andrews The cryoscopic method for the detection of added water in milk The determination of the freezing-point affords a simple and trustworthy means of detecting added water in milk Genuine milk has a freezing-point not higher than $-0\ 550°$ C, when determined by the method in use in the New Zealand Dominion Laboratory If the freezing-point rises to $-0\ 530°$ C, watering may be suspected, and if to $-0\ 520°$ C, the milk has certainly been adulterated with 5 per cent of added water —A J. Parker and L. S Spackman · Investigations on the relations between the acidity and freezing-point of milk The normal acidity of fresh milk is 0 14 per cent The correction factor is 0·003° C for each 0 01 per cent excess acidity between acidities of 0 17 and 0 60 per cent, and 0 010° C for acidities ranging from 0·14 to 0 17 per cent lactic acid When the cryoscopic method is used for the determination of added water in milk, it can be applied with accuracy only when the samples are quite fresh

Paris

Academy of Sciences, Feb 25—The president announced the death of M J Boussinesq—Charles Richet · Some statistics on the mortality and age of election of members of the Academy.—L. Cayeux Typical calcispheres are Algæ—Henri Villat. A problem of hydrodynamics — Guido Castelnuovo was elected *correspondant* for the Section of Geometry in the place of the late Luigi Bianchi—Paul Delens The differential geometry of spheres and groups of torsors —Marcel Vasseur Deformable surfaces with permanent conical network—Bertrand Gambier Quadratic solutions of Moutard's equations—Alexandre Ghika. The analytical prolongation of a given function by its development in Taylor's series—D Pompeiu A geometrical form of the fundamental theorem of Cauchy—Alex. Froda The relative maxima and minima of functions of real variables—Z. Horák The conditions of validity of Hamilton's principle—D Iwanenko · Two remarks on Dirac's equation—G. Ribaud and S Nikitine: The realisation of the black body at the melting-point of palladium by the tube method—H. Pelabon The electronic theory of bad contacts—Jean Lecomte · The elimination of diffused radiations in an infra-red spectrometer—Paul Bary and José V. Rubio Observations on colloidal solutions of alumina and chromium oxide and their desiccation—F. Bourion and E Rouyer: The determination by the boiling-point method of the molecular equilibria of resorcinol in solutions of lithium chloride. —A. Chrétien and E. Cornec The equilibria between water, sodium nitrate, and sodium chloride—Albert Roux and Jean Cournot · Combined influences of velocity of deformation and of temperature on the production of cold hardening.—B. Bogitch The reduction of fused silicates by carbon monoxide Silicates of copper Metallic copper is produced when the carbon monoxide amounts to 3 per cent of the gas mixture, when the percentage reaches 26 per cent the reduction of the copper is complete—Mlle. M Pernot · The system mercuric iodide, potassium iodide, and acetone—Mme Ramart-Lucas and Mlle Amagat The comparative stability of isomers according to their absorption spectra Allyl and isoallyl derivatives of the benzene series The absorption curves and thermal stability of these compounds are in agreement with the rules laid down by the authors in earlier communications—A. Michel-Lévy and Gaston Grenet · The relation between the increase of the magnetic susceptibility of certain heated rocks and the modifications which occur in certain of their mineral constituents —Paul Corbin and Nicolas Oulianoff Mylonitic zones with hercynian orientation in the massif of Mont Blanc—P Idrac Some singularities of the Gulf Stream—H Buisson Measurements of the ozone in the upper atmosphere during the year 1928—G Nicolas and Mlle Aggéry A Heterosporium parasite of *Viburnum odoratissimum*—Louis Rapkine The rôle of free oxygen in development—Takir Ertogroul · The origin of the peritrophic membrane in the silkworm—A Demolon and G Barbier The conditions of formation and constitution of the argilo-humic complex of soils The colloidal clay is a fixation factor of the humic colloids of soils The cations absorbed by the clay, especially Ca, condition the formation of clay-humus complex This complex can be reproduced starting with its constituents—Georges Lakhovsky Explanation of the therapeutic effects of open oscillating circuits on the organism of living beings—d'Arsonval Remarks on the preceding communication The application of Hertzian waves in therapeutics and their bactericidal action was utilised in France nearly forty years ago—P Lecomte du Nouy · The rotatory power of serum as a function of the temperature From a study of the rotatory power of normal horse serum for temperatures varying between 0° C and 70° C, it is concluded that up to 50°-52° C only very small changes occur in the chemical nature of the serum proteins for a time of heating of about two hours At 55° C a change is noted after twenty minutes heating, and above 59 C change is very rapid—Maurice Fontaine The increase in the oxygen consumed by marine animals under the influence of high pressures Its variations as a function of the duration of the compression The oxygen consumed by *Pleuronectes platessa* under pressures of 100 kgm. increases during the compression to a maximum, then diminishes, but remains for several hours above the normal consumption—P. Thomas, A. Gradinescu, and Mlle R Imas The utilisation of the pentoses in the animal organism.—Mlle. Andrée Courtois The small proportion of cholesterol in the fatty matters from the chrysalids of Lepidoptera

Geneva.

Society of Physics and Natural History, Dec. 20—R Bach and A Schidlof The allotropic states of iron It is generally admitted, from earlier researches, that iron has four allotropic varieties, α, β, γ, δ, and is characterised by the same crystal network for α, β, δ (centred cube), and another face-centred cube for γ The authors find confirmation of these views from the study of the variations of the constant of the crystal network in the neighbourhood of the transformation points of the different varieties—L Reverdin Faunistic study of the station of Sumpf (Zoug), the Bronze Age (2). The author completes the results of the excavations of 1926 by those of the years 1927 and 1928, obtained at two new places The numerical proportions of the different species vary from one field to the other, but the sheep preponderates. Taken as a whole, the descending order is sheep, ox, dog, pig, horse J Favre has determined the molluscs Those of the archæological layer are characteristic of aquatic deposits without exception. The presence of *Valvata piscinalis*, var *antiqua*,

shows that it was a lake and not a marsh.—F Battelli. The relation between the voltage and the duration of the stimulation in the production of convulsions. Continuous current and alternating current (frequency, 45), with the voltage rising from 10 to 86 volts, were applied to the frog For the lower voltages the action of the alternating current is much more prolonged, but the durations tend to equality starting from 45 volts

ROME

Royal National Academy of the Lincei, Dec 2.—Gino Fano. S. Lie's representation of the linear element of the plane on dotted space.—L. Cambi Univalent iron, cobalt, and nickel, and nitrosothio-salts: reply to W Manchot.—A Palatini: Constant tensors associated with binary and ternary varieties.—Maria Pastori Noteworthy identities relating to derived tensors.—C. Burali-Forti A question concerning elastic films.—E Čech. The asymptotic correspondence between two surfaces.—G Vranceanu: The equations of the problem of two bodies of variable mass Levi-Cività has recently considered the problem of the motion of a body, the mass of which varies as the result of the fall of meteorites on to it (astronomical case) and arrives at the conclusion that $\frac{d}{dt}(mv) = F$ should be taken as the fundamental law The equations of the problem of two bodies of variable masses, which is of astronomical interest, are now considered.—E Gugino A new interpretation of Gauss's principle of minimum contraction.—B Finzi The singularity of dynamic actions in the problem of the plane strip.—R Serini Symmetrical deformations of an elastic strip.—D. Graffi The theory of the transmission of heat by convection.—Stefano Lodovico Straneo Application of the functional method to the study of the cooling of a bar.—A Occhialini The effect of resistance on a spark spectrum A method is described which allows of the classification of the lines emitted by an element, and is based on their behaviour when a resistance is inserted in the discharge circuit Use is made of low voltage spark spectra, and, if the resistance is sufficiently high, the spectrum lacks certain lines, whereas if the resistance is diminished these lines appear adherent to the cold electrode in groups at definite values of the resistance.—M. Kahanovicz Elastic constants in relation to the periodic system of the elements Elasticities of form, volume, and tension are progressive functions of the atomic number The relationships are simple proportionalities, and the product of the modulus with the atomic number constitutes a constant characteristic of the group Various conclusions are drawn concerning the mutual relationships between the different deformations.—G Bargellini and Lydia Monti 2 5-Dichlorophenetidine The dichlorophenetidine obtained by Reverdin and During by treating phenacetin, in acetic acid solution, with nascent chlorine and hydrolysing the resulting dichlorophenacetin, is the 2.5-compound.—R Altschul A new procedure for staining glial cells. Weigert's method for revealing the marginal glia, the fibrous glia, and their relations to the vessels may be greatly simplified and rendered more certain in its results.—C. Ruiz The fauna of the Jurassic volcanic tufas of Roccapalumba, Sicily.—Constantino Gorino: Thermobiosis and microbic dissociation. By thermobiotic culture is meant, not adaptation of organisms to high temperatures, but treatment to ascertain if some of the cells are more or less thermophile. This is done by subjecting the cultures, suddenly and as soon as they are inoculated, to temperatures ranging from 50° to 70°, the daily re-inoculation of each culture being made at its own special temperature. In this way a mesophile species of the *Subtilis* group has been dissociated into a strain showing transitory thermo-tolerance and another exhibiting lasting thermo-tolerance.—G Testi Dragone: Fluorescence of vegetable juices in filtered ultra-violet rays. The experiments on the effects of the rays from a Hanau lamp, after passage through a uviol filter, on the latex from plants of various families, have now been extended to the resinous substances of a number of Coniferæ and to the essential oils of the pericarp of various *Citrus* species The resins exhibit fluorescence, which is usually blue, but sometimes greenish or brownish These substances, then, protect the parts of the organism producing them from harmful, invisible radiations by converting these latter into harmless radiations of greater wave-length. Similar results are obtained with the oleiferous glands of *Citrus*.—N. A Barbieri Physiological culture: results and applications. The author has previously shown that it is possible to separate, from vegetable tissues, the soluble and insoluble salts existing preformed therein These salts, as a whole, constitute the physiological fertiliser, which is the saline nutriment most suitable to, and most readily assimilable by, a plant Various crops, when fertilised on these lines, give favourable yields in comparison with similar crops to which the fertilisers commonly used are applied.—V. Bambacioni Contribution to the embryology of *Lilium candidum* L Various observations are recorded, of interest not only as regards the development of the feminile gametophyte which, perfectly identical with that of *Fritillaria persica*, follows the *Euphorbia dulcis* type and explains in the simplest manner the increase in the number of chromosomes in the nuclei of the chalazal region, but also on account of a number of anomalies, some not previously described

Official Publications Received.

BRITISH

The Hannah Dairy Research Institute Bulletin No 1 Surplus Milk and Milk Residues, being the Report of an Investigation into the Utilisation and Marketing of Surplus Milk and Milk Residues carried out for the Scottish National Milk and Health Association and the Empire Marketing Board By Archibald Macneilage, Jr Pp 66 (Glasgow The University) 2s 6d

The Journal of the Royal Anthropological Institute of Great Britain and Ireland Vol 58, July to December 1928 Pp xiv+305-564+17+plates 25-53 (London) 15s net

Report and Balance Sheet of the National Botanic Gardens of South Africa, Kirstenbosch, Newlands, Cape (and the Karoo Garden, Whitehill, near Matjesfontein), for the Year ending December 1927 Pp 25 (Kirstenbosch)

Quarterly Journal of the Royal Meteorological Society Vol 55, No 229, January 1929 Pp 102 (London Edward Stanford, Ltd) 7s 6d

Department of Scientific and Industrial Research Building Science Abstracts Compiled by the Building Research Station and published in conjunction with the Institute of Builders Vol 1 (New Series), No 12, December 1928 Abstracts Nos 2127-2293 Pp v+379-493 (London H M Stationery Office) 9d net

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The Indian Forest Records Silviculture Series, Vol 13, Part 7 Slash in Chir Pine (*Pinus longifolia*) Forests, Causes of Formation, its Influence and Treatment By J E C Turner Pp vii+46+25 plates (Calcutta Government of India Central Publication Branch) 3 6 rupees, 5s 9d

British Research Association for the Woollen and Worsted Industries Annual Report, 1928–29 Pp 60 (Leeds)

FOREIGN

Human Biology a Record of Research Vol 1, No 1, January 1929 Pp 152 (Baltimore, Md Warwick and York, Inc) 1 50 dollars

Proceedings of the Imperial Academy Vol 4, No 10, December 1928. Pp xxxiii-xxxiv+569 625 Vol 5, No 1, January 1929 Pp ii+56 (Tokyo)

United States Department of Agriculture Technical Bulletin No 98: Imported Parasites of the European Corn Borer in America By D W Jones Pp 28 (Washington, D C Government Printing Office) 10 cents

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 80 A Revision of Leidy's Collection of Mermithids By G Steiner Pp 547-552 A Collection of Birds from Siam By Rodolphe Meyer de Schauensee Pp 553-580 Studies on West Indian Mollusks the Genus Zachrysia By Henry A Pilsbry Pp 581-606 Notes on New Jersey Fishes By Henry W Fowler Pp 607-614 (Philadelphia)

University of California Publications in America Archaeology and Ethnology Vol 25, No 1 Lovelock Cave By Llewellyn L Loud and M R Harrington Pp viii+183+68 plates (Berkeley, Calif University of California Press, London Cambridge University Press) 2 50 dollars

University of California Publications in Zoology Vol 31, No 11 A Study of Physical and Chemical Conditions in San Francisco Bay, especially in relation to the Tides By Robert C Miller, William D Ramage and Edgar L Lazier Pp 201-267+5 charts (Berkeley, Calif University of California Press, London Cambridge University Press) 85 cents

Ministero dell' Aeronautica, Aviazione civile e Traffico aereo Annuario 1929 (anno 7) Pp 211 (Roma)

United States Department of Agriculture Technical Bulletin No 83 The Pacific Flathead Borer By H E Burke and A G Boving Pp 36 (Washington, D C Government Printing Office)

Publikationer fra det Danske Meteorologiske Institut Aarbøger Isforholdene i de Arktiske Have (The State of the Ice in the Arctic Seas) 1928 Pp 18+5 maps (København G E C Gad)

Marx-Engels Archiv Zeitschrift des Marx Engels Instituts in Moskau Herausgegeben von D Riazanov Band 2 Pp viii+613 (Frankfurt a M Marx Engels-Archiv Verlagsgesellschaft m b H) 12 gold marks

Memoirs of the College of Science, Kyoto Imperial University Series A, Vol 12, No 1, January Pp 80 Series B, Vol 4, No 2, February Pp 81-163 (Tokyo and Kyoto Maruzen Co, Ltd)

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West Africa Books, Maps and Views relating to the Gold, Ivory and Slave Coasts, Sierra Leone, Nigeria, Dahomey, Liberia, Benin, etc Pp 18 (London Francis Edwards, Ltd)

Diary of Societies.

FRIDAY, April 5

Institute of British Foundrymen (Lancashire Branch) (Annual Meeting) (at College of Technology, Manchester), at 4 —J Yates Foundry Organisation

Royal Sanitary Institute (at Council House, Birmingham), at 5 30 — H H Humphries Some Drainage Problems in Birmingham

Institute of Transport (Manchester, Liverpool, and District Section) (at Manchester), at 6 30 —D R Lamb Sidelights on the Transport Problem

Institution of Electrical Engineers (Meter and Instrument Section), at 7 —E W Hill Some Technical Considerations concerning Power Factor in Relation to Tariffs

Junior Institution of Engineers (Informal Meeting), at 7 30 —Technical Film showing the Production of Graham-Paige Cars in America

Institution of Mechanical Engineers (Midland Graduates' Section) (at Chamber of Commerce, Birmingham), at 7 30 —Wing-Comm T R Cave-Brown-Cave Aircraft Engineering in its Relation to Mechanical Engineering (Annual Lecture)

SATURDAY, April 6

Institution of Municipal and County Engineers (Yorkshire District) (at Town Hall, Leeds), at 2 30 —Resumed Discussion on the Address by W J Hadfield on The Local Government Bill and the Municipal Engineer, with Particular Reference to the Compensation Clauses

Hull Association of Engineers (at Technical College, Hull), at 7 15 — H E. Copp The Carbonisation of Coal

MONDAY, April 8.

Royal Society of Medicine (War Section) (Annual General Meeting), at 4 30 —Col J C. Kennedy, Surg Rear-Adml E T Meagher, Squad Leader M L Burton Discussion on Functional Diseases of the Nervous System

Victoria Institute (at Central Buildings, Westminster), at 4 30 —Lt - Col L M Davies The Philosophic Basis of Modernism

Royal Society of Medicine (Orthopædics Section), at 5 —W H Ogilvie A Review of Recent Work on Bone Tumours —R. Watson-Jones Wrist Dislocation with Associated Nerve Lesions

Royal Institution of Great Britain, at 5 —General Meeting

Society of Engineers (at Geological Society), at 6 —G H Gardner Notes on the Inspection of Public Works

Institution of Electrical Engineers (North-Eastern Centre) (Annual General Meeting) (at Armstrong College, Newcastle-upon-Tyne), at 7 — B L Goodlet The Testing of Porcelain Insulators

Society of Chemical Industry (Yorkshire Section) (Annual General Meeting) (at Hotel Metropole, Leeds), at 7 15 —Dr E G Ritchie The Storage of Steam in Industrial Plants

Royal Institute of British Architects, at 8 —Major-General Sir Fabian Ware . The Work of the Imperial War Graves Commission

Surveyors' Institution, at 8 —B W Adkin The Education of a Young Surveyor

TUESDAY, April 9

Society for the Study of Inebriety (at 11 Chandos Street, W), at 4 — Dr J D Rolleston and others Discussion on Alcohol in Therapeutics

Institution of Petroleum Technologists (at Royal Society of Arts), at 5 30 —Dr L Dudley Stamp The Oil and Gas Fields of Burma

Zoological Society of London, at 5 30 —S R Douglas Further Results of Dr Wilfrid Ashley's Experiment on marking Woodcocks breeding in the West of Ireland —J W Winterbottom Studies in Sexual Phenomena—Continual Display in Birds —W S Bristowe (*a*) The Mating Habits of Spiders, with Special Reference to the Problems surrounding Sex Dimorphism, (*b*) (1) The Spiders of the Scilly Islands, (2) The Spiders of Lundy Island, (3) A Contribution to the Knowledge of the Spiders of the Channel Islands —C J Conolly A New Copepod Parasite representing a New Genus and its Larval Development

Institution of Civil Engineers, at 6 —H Hall The New Piccadilly Circus Station

London Natural History Society (at Winchester House, Old Broad Street), at 6 30 —J E S Dallas Summer in Switzerland

Institute of Marine Engineers, at 6 30 —W E Woodeson, jun, and J S Gander The Relative Merits of Pulverised Fuel and Mechanical Stoking and their Application for Marine Purposes

Institution of Electrical Engineers (North Midland Centre) (at Hotel Metropole, Leeds), at 7 —Annual General Meeting

Institution of Electrical Engineers (North-Western Centre) (Annual General Meeting) (at Engineers' Club, Manchester), at 7 —Hon Sir Charles A Parsons and J Rosen Direct Generation of Alternating Current at High Voltages —J A Kuyser Recent Developments in Turbo-Generators

Institution of Electrical Engineers (Scottish Section) (Annual General Meeting) (at Royal Technical College, Glasgow), at 7 —E B Wedmore, Dr W B Whitney, and C E R Bruce An Introduction to Researches on Circuit Breaking

Royal Photographic Society of Great Britain, at 7 —S H Horgan Bringing Photography to the Printing Press

North - East Coast Institution of Engineers and Shipbuilders (Middlesbrough Branch), at 7 30

Institution of Engineers and Shipbuilders in Scotland (at 39 Elmbank Crescent, Glasgow), at 7 30 —Dr -Ing F Sass Experiences with and Investigations on Double-acting Airless injection Diesel Engines

Institution of Automobile Engineers (at Royal Society of Arts), at 7 45 —H S Rowell and C G Williams Automatic Spark Advance

Royal Society of Medicine (Psychiatry Section) (jointly with British Psychological Society, Medical Section), at 8 —Dr E Jones, Dr H Yellowlees, Dr R D Gillespie, and others Discussion on The Role of Anxiety in the Psychoses and Psycho neuroses

Television Society (at Engineers' Club, Coventry Street), at 8 —J C Rennie Some Notes on Exploring

WEDNESDAY, April 10

Institution of Electrical Engineers (Wireless Section), at 6 —T L Eckersley Short Waves

Malacological Society of London (in Zoological Department, University College), at 6

Royal Society of Arts, at 8 —G H Nash Some Modern Aspects of Electrical Communication

Electroplaters' and Depositors' Technical Society (at Northampton Polytechnic Institute), at 8 30 —B Clark Effect of Organic Addition Agents in the Electro deposition of Copper

THURSDAY, April 11

Textile Institute (at Midland Hotel, Bradford), at 2 30 —H T Tizard Science and the New Industrial Revolution (Mather Lecture)

Institution of Electrical Engineers, at 6 —B L Goodlet The Testing of Porcelain Insulators

Royal Aeronautical Society (at Royal Society of Arts), at 6 30 — M Lapresle Wind Tunnel Methods of the Eiffel Laboratory

Institute of Metals (London Local Section) (Annual General Meeting) (at 83 Pall Mall), at 7 30 —Dr Hankins and others Discussion on Hardness Testing

Royal Society of Medicine (Neurology Section), at 8 30 —Discussion on Disseminated Encephalo-myelitis

Nelson Textile Society (at Nelson) —F Hughes Sley Construction and Traverse of Shuttle

FRIDAY, April 12

Royal Society of Arts (Indian Section), at 4 30 —A T Cooper Recent Electrical Developments in India

Royal Astronomical Society, at 5 —L Rosenhead The Annual Variation of Latitude —E A Kreiken On the Dwarf Nature of the Spectroscopic Binaries —H Horrocks The Longitude of the Royal Observatory, Cape of Good Hope, from Wireless Signals, Oct -Nov 1926 —S A Mitchell Atlas Stellarum Variabilium, Series VII

North - East Coast Institution of Engineers and Shipbuilders (at Mining Institute, Newcastle-upon-Tyne), at 6

Society of Chemical Industry (Manchester Section) (Annual General Meeting) (at Engineers' Club, Manchester), at 7 —T R Woolaston Suggestions in Steam Raising

Institution of Mechanical Engineers (Informal Meeting), at 7 — F E F Durham Pumping Plant

Geologists' Association (at University College), at 7 30 —E J Wayland The Later Geological History of the Equatorial Lakes in Uganda

Oil and Colour Chemists' Association (Manchester Section) (at Milton Hall, Manchester), at 7 30 —Annual General Meeting

Society of Chemical Industry (Birmingham and Midland Section) (jointly with Chemical Engineering Group) (at Engineers' Club, Birmingham) —Dr C M Walter The Design and Operation of Gas Heated Furnaces

SATURDAY, April 13

Institution of Municipal and County Engineers (jointly with Yorkshire and North-Western Districts) (in College of Technology, Manchester), at 2 30 —W J Hadfield The Local Government Bill, with Particular Reference to the Road Clauses

SATURDAY, APRIL 13, 1929.

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No. 3102, Vol. 123]

Co-education.

SCIENCE does not give a clear lead on the question of co-education. The physiological and psychological differences between the sexes are not 'significant' enough to determine whether the sexes should preferably be educated together or apart. When in 1922 the Consultative Committee of the Board of Education was preparing its valuable report on "Differentiation of the Curriculum for Boys and Girls respectively in Secondary Schools," it wisely consulted a distinguished medical man, the late Dr. J. G. Adami, on the anatomical and physiological differences between the sexes. Dr. Adami classified those differences under four headings—(*a*) rate of growth; (*b*) date of adolescence, (*c*) anatomical age, and (*d*) after puberty, the composition of the blood—and gave the Committee all the information available on the interrelationship of the internal secretions and the essential and secondary organs of sex, for, as he said, "obviously it has a profound bearing upon the problem before the Committee."

The lower proportion of red blood corpuscles in women has been established by several workers. Dr. Adami discussed at some length recent work on the calcium metabolism of the body, referring especially to Blair Bell's conclusion that, with the onset of puberty, the calcium metabolism in the female becomes unstable, whereas in the male it remains comparatively constant. The committee observes that at that time Blair Bell's views had not been generally accepted by physiologists, but it appeared possible that the greater nervous excitability of the feminine sex might be ascribed to a deficiency in calcium. If the Committee showed a disposition to study its problem in the dry light of science, its recommendations stressed the need for further inquiries rather than the value of results already attained.

It must be remembered that the Consultative Committee was not concerned directly with the question of co-education. Evidence on this question was, however, received, and a digest is given in an appendix. The questions considered refer to the relations between boys and girls in mixed schools—whether, for example, boys tend to take a preponderating part in the social life of the school—the danger of overpressing girls and not pushing boys forward sufficiently, the relative failure to meet the individual needs of some girls, and, finally, staffing difficulties. These last appear to be the most serious, for the position under which mixed schools are, with some exceptions, under the control

of head masters, does not appear to offer a final solution Women's education has already suffered too much from 'man-made' curricula, and a state of things in which all the responsible appointments in secondary education are held by men would not be acceptable to women under present social and political conditions

Originally, in Great Britain, as in the United States, the establishment of mixed secondary schools took place without much premeditation The geographical distribution of these schools in England is curious Buckinghamshire, Derbyshire, Durham, Gloucestershire, Hampshire, Lancashire, Middlesex, Suffolk, Wiltshire, and the West Riding appear to like mixed schools, Kent, London, Northumberland, Staffordshire, Surrey, and Warwickshire appear not to like them. Lancashire has thirty-three mixed schools and thirty-eight boys' schools under the county authority, London has three mixed schools compared to forty boys' schools. Mr R F Cholmeley, in his chapter on the boys' day school, contributed to "The Schools of England," edited by Prof Dover Wilson, remarks that the origin of most of these mixed schools is due to convenience, including financial convenience, but he adds that "the interesting thing about them is the growth of a belief in them on educational grounds, and the remarkable success of their work" He regards the growth of the mixed school as one of the most striking developments in day school education The proportion of mixed schools to boys' schools is almost exactly seven to eight, and the number of boys educated therein as two to five

If the growth of the mixed school has been without premeditation, the same may be said of the growth of the girls' secondary school and college. The pioneers of women's education saw the nakedness of the land and established new schools and colleges for girls and women, making, at the same time, a reasonable claim to a small share of educational endowments. The University of London was an early convert to co-*examination*, admitting women to all examinations in 1878, with the significant reservation that "no female graduate of the said University shall be a member of Convocation of the said University, unless and until such Convocation shall have passed a resolution that female graduates be admitted to Convocation." Here we see obtruding the old and difficult question of control, a question of much controversy also at Oxford and Cambridge In London this question has advanced a distinct stage under the new statutes which grant official membership of the Senate to the heads of several women's colleges, an 'ability' accorded to women which will be generally approved, as it seems desirable to ensure the inclusion of women on the governing bodies of universities

In the British universities generally, co-education prevails and is unavoidable in the case of subjects studied by a small number of students Oxford, Cambridge, and London, partly owing to their collegiate organisation, present some special problems

The question of medical co-education in London has been widely discussed in consequence of the decision of several medical schools in future to exclude women students, a reversal of the policy adopted during the War The usefulness of the Report of the Committee of the Senate of the University of London on this subject is, however, reduced, because it was not found possible to state specifically the reasons which led the medical schools in question to this decision; nor is there any report by the Faculty of Medicine, the advice of which we should have expected the Senate to seek on constitutional grounds The committee states. "We are unable to see any valid argument on the merits against the provision of co-education in medicine. The pre-possession of the University is in favour of such co-education" Seeing that a large majority of the existing colleges of the University are uni-sexual, and that seven medical schools have recently expressed a preference for uni-sexual education, it is difficult to see on what evidence this 'pre-possession' is based Statistics appended to the Report indicate that there is at present no difficulty in women undergraduates obtaining medical education; for whereas in 1920–21 the London School of Medicine for Women had 447 full-time students, that number had fallen in 1926–27 to 297. The throwing open of the other medical schools to a 'quota' of women would tend to reduce the success and efficiency of this well-organised school for women. Apart from this, is not the 'quota' system inherently objectionable? The University would do well to ensure that all special courses, especially those by research workers at the spear-head of knowledge, should be equally available for men and women At the moment, no further action on the part of the University appears to be demanded.

Since the publication of the University of London Report, an important opinion on the question of medical co-education has been pronounced by Dr. Louisa Garrett Anderson, who, at a meeting held at the London School of Medicine for Women on Mar 21, said that a medical school

for women alone had enormous advantages over a co-educational school. Where women held the professorial chairs, she added, women learned to trust women; but where there was co-education it had been found that the most important work was done by men As the Senate Committee, though in its nature a lay committee, did not attempt to quote expert opinions for and against medical co-education, this professional opinion by a leading woman doctor comes at a convenient moment and should carry great weight.

The general tendency of co-education is towards creating large institutions Co-educational secondary schools of 5000 pupils are not uncommon in the larger American cities. Co-education also facilitates a preponderance of one sex or the other in the teaching staff, whereas with separate schools there is a natural tendency towards an approximate equality In some of our co-educational colleges, women do not appear to have obtained a fair proportion of the staff appointments. Nor can co-education offer much encouragement to specialisation on sex lines which may be desirable in certain subjects, *e g* medicine. In higher education, which demands consecration and dedication, the presence of the other sex may act as a distraction Frank R Arnold, in an article "The Mating Season of Co-education" (*Scribner's Magazine*, June 1926), refers to "co-educational calf-love," and argues that the finest type of woman is not likely to be produced by co-educational institutions Such women "need years of meditative acquisition, mental brooding as well as physical, and the fault of co-education is that it awakens the mating mother instinct too early."

The Planetesimal Hypothesis.

The Two Solar Families the Sun's Children By Prof Thomas Chrowder Chamberlin. (University of Chicago Science Series) Pp. xxii+311 (Chicago · University of Chicago Press, London Cambridge University Press, 1928) 12*s* 6*d*. net

THIS book, which appeared on the author's eighty-fifth birthday, and less than two months before his lamented death, is a summary of the well-known planetesimal hypothesis of the origin of the solar system which, with the collaboration of Prof. F. R Moulton, he developed during the last thirty years While the greater part of the book is a restatement of previously published results, some new material is included, and the whole forms a compact and useful account of a hypothesis which, whatever may be its ultimate fate, must take high rank among the generalisations which have stimulated and elucidated geophysical research during this century.

The "two solar families" are, in broad terms, the planets and the comets The former class includes the major and minor planets and their satellites, and the latter the chondrulites, comets, and meteorites. In "the grey beginning of years," a star passed near the sun, and by tidal action, aided by propulsive forces in the sunspot zones, drew forth a succession of 'bolts' from the near and far sides of the sun These bolts rapidly cooled and were largely disintegrated into a multitude of 'planetesimals' which, in the course of long ages, were gradually reabsorbed by the residual nuclei of the bolts, forming the planets The cometary family owed little, if anything, to the passing star It arose from material ejected from the sun in the manner of the eruptive prominences which are even now frequently observed The hypothesis is extended in an ingenious way, without excess of purely *ad hoc* assumptions, to explain many details of the present solar system. Prof Chamberlin's account is not distinguished by marked clearness of expression, but it is in the main free from ambiguity, and the meaning is rarely obscure to the careful reader A bountiful provision of good diagrams and illustrations, and excellent productive work on the part of the publishers, make up a worthy conclusion to the author's long series of contributions to geology and allied sciences.

The publication of the book has seemed to Prof. Moulton a fitting occasion to direct attention to certain matters connected with the planetesimal hypothesis and its reception among astronomers. He has accordingly issued a pamphlet entitled "The Planetesimal Hypothesis," in which several important points are raised It is made up of two distinct parts, which may be described succinctly as constructive and destructive. They are not entirely unrelated, for the instruments forged in the former are used as weapons in the latter, and in fact were clearly designed for that end, but the division is nevertheless a convenient one.

In the constructive part a sharp line is drawn between hypotheses of the Laplace type and those of the planetesimal type "The gap between these different genera of intellectual constructions is as profound as that between different genera of living organisms, and as difficult to bridge" The characteristics of the genera are described by examples instead of specific statements, but it is clear that the typical feature of the former is the idea that the evolution of each cosmic mass is free from extraneous influences and consequently can be traced out rigorously

from a few fundamental principles in a statement of great simplicity If intra-atomic sources of energy are ignored, these hypotheses require a cosmic time-scale of tens of millions of years Hypotheses of the planetesimal type, on the other hand, regard the stars as mutually related objects, the evolution of each depending in part upon the others. The simplicity of the former type does not exist, so that some parts of the planetesimal hypothesis may be accepted and others rejected The time-scale required here is of the order of thousands of millions of years

Later in the pamphlet another classification is advanced which distinguishes hypotheses which are expressible in formulæ from those which are not Prof Moulton well explains the character of a 'formula' or 'law of Nature,' and although he does not actually state that this classification is a restatement of the former one, it may fairly be inferred that that is so. The Laplacian theory and the Genesis account of creation are cited as examples of hypotheses expressible by simple formulæ, and the planetesimal hypothesis as an example of the other kind

So much for the constructive side of the pamphlet, now for the destructive side This originates in the relations between the planetesimal hypothesis and the views of Sir James Jeans and Dr Harold Jeffreys on the origin of the solar system, which are mainly contained in "Problems of Cosmogony and Stellar Dynamics" (1919) of the former and "The Earth" (1924) of the latter The theories of Jeans and Jeffreys both invoke a passing star to produce the planets from the sun by tidal action, but the conditions of the process and the subsequent developments differ in the two theories, as does each of them from the planetesimal hypothesis

Prof Moulton first protests against the frequent ascription of the assumption of a passing star, and the proof of the invalidity of Laplace's hypothesis, to Jeans instead of to the prior work of Chamberlin and himself Further, although the time-scale of cosmic processes has lately been greatly extended through the discovery that intra-atomic energy might be available for stellar radiation, no adequate acknowledgment has been made of the fact that this possibility was urged by Chamberlin nearly thirty years ago

This, however, is not all Prof Moulton goes on to denounce the methods of Jeans and Jeffreys in claiming credit by implication for Chamberlin's work. He complains that these writers give the impression that the idea of a passing star and allied conceptions are mainly due to British workers, and that they do not fairly indicate the date of birth of the planetesimal hypothesis, so that priority is likely to be wrongly assigned. He gives a history of the development of that hypothesis and compares it with the later work of Jeans and Jeffreys, concluding that the 'tidal theory' of these writers is identical in every essential concept with the planetesimal hypothesis and that the former is an abortive attempt to put the latter into a formula

From the point of view of scientific history and general principles, Prof Moulton's pamphlet has much importance and some justification There seems to be no doubt that due acknowledgment has not generally been given to the work of Prof Chamberlin and himself with respect to the assumption of a passing star, the criticism of Laplace's hypothesis, and the realisation of the factors determining the cosmic time-scale The planetesimal hypothesis is clearly entitled to very serious consideration, yet it has rarely been considered seriously outside the works of the authors themselves It is easy to find reasons for this, but difficult to find excuses. We hope the pamphlet will make it unnecessary to look for them in the future

Very pertinent also are Prof Moulton's remarks concerning the significance of formulæ. A mathematical statement undeniably carries with it an air of authenticity which does not usually accompany general descriptions, although the latter may involve greater imaginative insight and approach more nearly to the actual happenings of Nature In the attempt to reconstruct cosmic history, the inquirer may be actuated by either of two motives. he may believe that something actually occurred in pre-human times, and seek to discover what it was, or he may be concerned to weld together observed phenomena into a consistent logical scheme, and introduce the past as a useful parameter without necessarily assigning to it the dignity (or indignity) of actuality Usually, perhaps always, the two motives are mixed, but on the whole the former predominates in the descriptive, non-mathematical theorist, and the latter in the mathematical physicist So long as our knowledge is partial, at least, the two motives will urge the inquirer along diverging paths. We are glad that Prof Moulton has had the courage to insist that one is not inevitably more valid than the other

Having made so clear a distinction, however, Prof Moulton most surprisingly fails to preserve it, and as a result we have his vigorous criticism of Jeans and Jeffreys which his own general principles, if properly applied, would discredit The starting-point and sole sanction of the attack is the assump-

tion that the 'tidal theory' of these writers is merely a vain attempt to formularise the planetesimal hypothesis and consequently is separated by a profound gap from hypotheses of the Laplace type. It is difficult to understand how such an assumption could be made, for there could scarcely be a more typical example of the Laplacian type of hypothesis than the tidal theory. It has, in common with the planetesimal hypothesis, the assumption of a passing star as the origin of the whole process, but the subsequent development is so profoundly different in the two lines of thought that the bodies which give the name to the hypothesis of Chamberlin and Moulton do not exist in that of Jeans and Jeffreys

Extracts from prefaces will perhaps make this clear. Jeans writes: "The present essay is primarily an attempt to follow up a line of research initiated by Laplace and Maclaurin, and extended in various directions by Roche, Lord Kelvin, Jacobi, Poincaré, and Sir G. Darwin" Prof Moulton's examples of the Laplacian type of hypothesis are the works of Laplace, Helmholtz, Sir G Darwin, and Lord Kelvin. Jeans continues "When a firm theoretical framework had been constructed, it seemed permissible and proper to try to fit the facts of observational astronomy into their places." Chamberlin, on the other hand, was led to theoretical discussion by a desire to explain geological facts. "We may make the vestiges of the genetic events serve as our guide. All the peculiarities of the planetary system . . . should serve as system-pointers to the true interpretation."

Again, Jeffreys writes: "Quantitative comparison of theory with fact has always been the main object of the book." Clearly it is the 'formula' type of theory that is attempted here

Prof Moulton's attack on Jeffreys's 'tactics' is regrettable and, it appears to us, without justification It is unfortunate that Jeffreys does not give a specific date to Chamberlin and Moulton's work, but the character of his discussion of it is not fairly indicated in the pamphlet. After very favourable mention in Chap. ii. it is discussed in an appendix of seven pages beginning · "The Planetesimal Hypothesis was historically the parent of the Tidal Theory. . . It was invented by T C Chamberlin and F R. Moulton in the early years of the present century, and detailed accounts of it may be found in" (three sources) Since Prof. Chamberlin gives 19 references to original papers on the hypothesis, excluding its exposition in books, Jeffreys's date is perhaps as specific a one as could conveniently be given, and should certainly mislead no one in the matter of priority. The historical importance of the hypothesis is again emphasised at the end of the appendix

We are convinced that Prof Moulton's charge of national jealousy is unfounded, and the foregoing quotations appear to us to be strong evidence on this point It will nevertheless be appropriate to examine the matter more generally An analysis of the personal references in the indexes of the books here considered reveals the following percentage figures

	References to		
	English Writers	American Writers	Others.
Chamberlin	13 1	65·6	21·3
Jeans	22 8	37 9	39 3
Jeffreys	58·6	16 8	24 6

Prof Chamberlin's book has been included, not in order to criticise his neglect of non-American work, but to show the inevitability of an apparently undue emphasis on the work of one's own countrymen in any original investigation We do not complain of Prof Chamberlin's 'tactics' we go to his book for an account of the planetesimal hypothesis, which was indisputably made in America But we do think that Sir James Jeans and Dr Jeffreys are entitled to a similar consideration. Their theories are as original as Prof Chamberlin's, and we hope that Prof. Moulton's just objection to a general neglect of Prof. Chamberlin's work will no longer be weakened by an unjust attack on the work of others H. D.

The Study of Corals.

Catalogue of the Madreporarian Corals in the British Museum (Natural History). Vol. 7 · *A Monograph of the recent Meandroid Astræidæ.* By Prof George Matthai Pp. v + 288 + 72 plates. (London British Museum (Natural History), 1928.) n.p

THE existing corals are the most unsatisfactory group of the animal kingdom from a systematic point of view They are accursed in that they have supposed ancestors and relations so far back as the early Cambrian, the play of stratigraphers, who care not for life Their most prominent feature is an exo-skeleton of carbonate of lime, which is neither for protection nor for muscular attachments, both of which are reflected in those of vertebrates and arthropods. There are radiating plates (septa) from centres, over which lie the mouths (stomodœa) of the anemones (polyps) that are seated upon them. Other structures are central columns (columella) and surrounding walls, all free edges toothed perhaps, and the skeleton (corallum) goes on perpetually thickening so long as the

anemones live There is immense variation in the size and height of septal teeth, and the septa vary in length, height, and thickness, as do all other structures, in correlation with rapidity of growth, with incidence of light, with water movements, and so on Systematy becomes worse in ' colonial ' or many mouthed or polyped forms, for these show in addition, more clearly correlated with environment, variation in the position and rate of production of new polyps such as to give wide differences in the coralla All modern reef builders have algæ living and reproducing within their polyps, and these we judge to be the most important factor in their nutrition They, like the chlorophyll in the tree, may produce vast modifications in the growth form of their host

Yet modern corals must be classified for the sake of the palæontologists, who have to make their deductions as to the fossil species from the analogous living forms, if for no other people About half a century ago their skeletons were all we really knew. They were supposed to be internal before von Koch found them to be formations or precipitations outside the animals Then the anatomy of the polyps was partially cleared up by von Koch and by von Heider, Fowler, Bourne, and Duerden, amongst others, while Wayland Vaughan, by his studies on both living and fossil corals, greatly enriched our knowledge The barrenness and inadequacy of any systematic study based on corallum alone was made clear. Yet, to bring conviction, the attempt had to be made to bring order out of confusion on the old lines, and the Natural History Museum issued six catalogues dealing with eight genera Brooks and Bernard ' made confusion worse confounded ' The latter never examined scientifically even a single coral polyp, and yet stated that their skeletons " follow the growth of the polyps closely." He was unable to determine his species, and adopted a geographical arrangement, for example, enumerating twenty-four forms, which he termed " Porites Fiji Island, 1–24 " ; growth forms are correlated with localities rather than with environments. These catalogues were misfortunes, sheer waste of money, which could have been avoided if any member of the Museum staff had been sent to any coral reef for six months' study of the living forms.

It was at this stage that Prof. Matthai commenced his researches eighteen years ago He made a profound study of polyps and coralla together, specialising on the massive, many polyped Astræidæ, some of which have separate seats for each polyp, separate corallites, while others have meandering valleys with many stomodœa Of the former he had more than eight hundred specimens in the collections at Cambridge, and he examined the polyps of seventy-five of these by sections He also worked over the collections of Glasgow and of most of the European capitals, in which he found 590 colonies. His results (*Trans Linn Soc*, **17**, 1914) reduced the described species by three-quarters, and he showed that, once the polyp form of a species was determined, the species could be recognised by coralla alone. Hermaphroditism was seen to be a common phenomenon, and fission of the polyps by division through their stomodœa was proved not to exist, thus upsetting a main character in all former classification

Prof Matthai then extended his researches to the reefs of the West Indies and, *en route*, examined many of the Dana and other types in the United States His "Colony Formation in Astræid Corals" (*Phil. Trans. R S*, 1926) sets out two modes of polyp budding, inside and outside their tentacular rings. The extratentacular budding corals have only a single stomodœum within each circle of tentacles, whereas the intratentacular are di-, tri-, or poly-stomodœal, the stomodœa joined to each other by either one or two couples of mesenteries The foundation of the long meandering valleys of the brain corals was made clear. *Hydnophora* is the extreme case ; its monticules are isolated bits of corallite walls, while the polyp surface between has vast numbers of stomodœa, the ' colony ' being really a single poly-stomodœal anemone, seated on a coral base of complicated plates and walls

The systematic examination of the vallied Astræidæ was the test required for these results The Cambridge collections, both of these and of the genera previously examined by Matthai, were given to the Natural History Museum, together with all sections, etc, for permanent reference The Museum at once offered to print a catalogue, and this has now appeared, with such a wealth of illustration that, be the system correct or not, we have a mass of information from which any subsequent researcher may conveniently start. Matthai's services were given under considerable personal sacrifice, but he should be satisfied with the results, which reflect the highest possible credit on himself and on the Indian Educational Service to which he belongs. This is a strong statement, but I confess that I was sceptical as to the application of his theoretical paper to systematy. As a result, I have been testing his methods and conclusions as to the species of his corals off and on, since I first learnt them, more than a year ago. I

find they work with comparative ease, and I have no advantage over any other systematist save a very limited acquaintance with corals as living organisms

The secret expounded by Matthai is first to study the polyps, none of which have directive mesenteries, to determine how they form fresh mouths, and this gives the clue to valley formation, etc He finds the same methods in quite diverse colonies, these form a genus to be further divided into species on other anatomical characters The mesenteries joining stomodœa, the varied forms of nematocysts, and the number of principal mesenteries are some of the accessory characters of his polyp-key. Those chosen for the skeleton-key are septal margins toothed or not, septa thick or thin, columella present or absent, and lamellar, dense or trabecular, etc, these, unfortunately, bear a minimal relationship to the growth methods of the polyps, with which the mesenteries of the first key are concerned Each key will help the systematist to name, but the corallum key gives no clue to the phylogeny of the group, as to which the author rightly speculates The interesting fact appears that of the 28 genera described, 16 are confined to the Indo-Pacific and 12 to the Atlantic, their centres respectively in the East and West Indies Ten of the genera are monotypic, while 10 others have 2 species each Of the more abundant brain corals, the Indo-Pacific *Cœloria* has 4 species (2 new) in place of 16, and the Atlantic *Mœandrina* 3 in place of 28. *Mussa* of the West Indies—it is a pity that Matthai could not obtain polyps—is stated to be monotypic, whereas its supposed Indo-Pacific forms are placed in three species of *Lobophyllia*, which would be easier to follow were their numerous figures less scattered in the plates

In conclusion, we congratulate the Directors and the Keepers of the Natural History Museum that have been concerned on their bravery and scientific acumen in recommending the publication of this catalogue, after six previous quite disastrous volumes. The refiguring by photographic methods of a large number of 'type specimens' in many museums is of immense value, and only made possible by the recognition that science is international This shows a healthy spirit in zoological science, as does the co-operation of directors and collectors with a real worker On the whole, I am disposed to consider that the method here sketched is almost the last word so far as the anatomy of 'wild' species is concerned, and for the next advance I look to experiment and to a study of the whole physiology of coral polyps, particularly to that of corallum formation That many species are adapted to wide changes in salinity, in temperature, in currents, in mud content of the water, in light, in phosphate content (especially in connexion with the commensal algæ), etc, is certain. All these are felt by the living polyps and are reflected in the growth of large colonies We must know here more about our living beasts before we study further their systematy

J Stanley Gardiner

The Origins of European Culture.

The Most Ancient East: the Oriental Prelude to European Prehistory. By Prof V. Gordon Childe Pp xiv + 258 + 24 plates. (London: Kegan Paul and Co, Ltd., 1928) 15*s* net.

A NEW book by Prof V. Gordon Childe is always welcomed by students, and the volume under notice has special value as it carries the history of European cultures, as described in his "Dawn of European Civilization" (1925), to their origins in the ancient East, for the whole chronology of prehistoric Europe ultimately rests on synchronisms with the historical cultures of Babylonia and Egypt. The book begins with a reconstruction of the culture of the then thickly populated pleasant grass-lands of northern Africa and southern Asia of late palæolithic times Firm ground is reached in the description of the culture recently found at Badaria, south of the Fayum. Culturally, the immigrant Badarians were a whole stage removed from the savagery of the Capsian hunters; they had mastered all the arts that are usually termed neolithic, and in addition they were acquainted with copper. The Badarians may have been autochthonous in the Nile valley or somewhat farther east, the modern Hadendoa appear to have relations with this ancient stock They were the founders of Egyptian agriculture Later, the first pre-dynastic culture arose in Upper Egypt from this basis and an infiltration of Getulian elements from the west

The First Dynasty of Babylon can be fixed at 2196 B.C., but long before this there are written records of kings of various cities that date back to an event termed the Flood, and even earlier. The First Dynasty of Ur dates from before 3000 B.C., and belonging to a period some 500 years earlier are the royal tombs excavated by Mr. C L. Woolley. Those who have seen his exhibitions in the British Museum will recognise that this very rich and mature civilisation must have had a long history behind it Gordon Childe discusses the character and affinities of the first and second prediluvial

cultures; the former is mainly revealed from excavations at Susa (S. I) and at al'Ubaid, the latter is that of Susa II and of other sites.

As we have the first account in book form of the Badarian culture, so also we have that of the Indus civilisation We find, thanks to work of Sir John Marshall, on the now impoverished banks of the Indus a brilliant civilisation in touch at once with the prediluvial villages of the Iranian plateau and the nascent city-states of Babylonia, and the Arabian Sea was ploughed by dhows freighted with the stuffs of Sindh consigned to Babylonian river towns Thus the civilisation of Sindh was ahead of that of Sumer. About 3000 B.C a catastrophe overtook the cities of the Indus basin Gordon Childe thinks it is a legitimate deduction that the rôle of the maritime peoples of Arabia was to act as intermediaries between Egypt, Mesopotamia, and India.

This book should be of definite interest to the non-specialist reader, as it is pleasantly written, copiously illustrated, and will enable him to place in their historical setting the discoveries that are continually being noticed in the daily Press.

A. C H.

Our Bookshelf.

Morpheus. or the Future of Sleep. By Prof. D. F Fraser-Harris (To-day and To-morrow Series.) Pp. 94. (London Kegan Paul and Co., Ltd.; New York: E P. Dutton and Co., 1928) 2*s*. 6*d* net.

A NUMBER of eminent men of science have contributed to the admirable series to which this little book belongs, and success has attended their efforts varying with their ability to cast aside professional restraints and speak their adventurous and unguarded minds. If the unsophisticated reader is willing to add Dr. Fraser-Harris's name to the list, it will be for reasons which are unfortunately concealed from the specialist. No subject could offer a greater opportunity for daring and ingenious speculation founded in scientific fact; but Dr Fraser-Harris prefers to follow (rather lamely) the story of the journals. On p 11 expectation is aroused by the statement that "comparatively few people could tell us exactly what it is that makes us sleepy and finally permits us to go to sleep" Gall, Mosso, Pupin, Claparède, Ramon y Cajal, Duval, Howell, Coriat, and Pavlov did not claim to do more than suggest tentatively, and while the author gives some account of their work, it is for the most part shorn of those honest doubts and reservations which somehow constitute a real contribution to the subject. Finally, he takes refuge in that disastrous propensity of physiologists confronted with conflicting streams of evidence, the 'omnibus' theory. Thus we have the absurdity: 'types' of sleep (p. 26). Particularly it is confusing to see Pavlov taken into the omnibus. First among physiologists he seems to have broken with the earlier inactivity theories completely. There is still the problem of sleep

Some serious errors are made. The granules of Nissl are scarcely "rod-like" and they certainly are not to be found in the nuclei of nerve-cells in any circumstances, as Dr. Fraser-Harris implies (p 25) The dream does not appear to have a very respectable biological ancestry if all we can say is that "we are entitled to assume that certain animals, for instance the dog, can dream" For many animals the dream is a most important protective mechanism "The speech centres in the frontal lobes" does some injustice to several workers, and it is to be doubted whether insistence upon the hallucinatory character of dream images is to be commended even in a popular work Several passages suggest that Dr Fraser-Harris has not observed the manias associated with low blood-pressure. Whether there "seems no reason to doubt that . information is conveyed telepathically or directly to the brain without having been communicated through any of the sleeper's organs of sense" (p 77) is a matter of opinion, as is also the statement "that some dreams are the expression of ancestral memories is an attractive theory" (p. 78)

The future of sleep is discussed in sixteen pages. Evidently its security will depend largely upon social and political agitation for the suppression of its prolific modern enemies

Elements of Alternating Currents and Alternating Current Apparatus By Prof J. L Beaver. Second edition. Pp. xiii+393 (New York, London and Toronto: Longmans, Green and Co, Ltd, 1928.) 18*s*. net

THIS book is written mainly for the benefit of those commencing the study of alternating currents. The numerical examples are numerous, and a very fair attempt has been made to explain away the difficulties which every one experiences in studying the subject. For those who have not the benefit of a teacher, numerous references are given to papers and other text-books where fuller explanations will be found. Some of these papers, as, for example, the *Bulletins* of the General Electric Company of America, cannot easily be obtained on the eastern side of the Atlantic The nomenclature used is mainly that standardised in America. Capacity is called capacitance and a condenser is sometimes called a 'capacitor.' Possibly this is to prevent confusion with a steam condenser, which is quite a different device It has long been thought desirable by electricians to standardise the termination 'or' to designate a piece of apparatus. But the difficulties in the way seem insuperable. Arrestor, startor, and divertor are coming into use, but exciter, damper, and feeder still have the 'er' termination.

Naturally, in an elementary book it is difficult, if not impossible, to state the theorems rigorously and to give their limitations We think, however, that a word of warning might have been added on

p. 166 to the formula given for eddy current losses. On p. 44 it is misleading to state that the 'convex surface' of a conductor carries the high-frequency current In a concentric main with high-frequency currents the current nearly all flows near the concave surface of the outer conductor, the current near its convex surface being almost negligible On p. 107 the method of representing a vector by a complex number is attributed to Dr. Kennelly. Mathematicians usually attribute it to J. R. Argand (1806), but it seems to have been previously used by Gauss and Wessel (1797)

L'Industria chimico-metallurgica del solfato di rame e le miscele cupriche funghicide ed anticrittogamiche. Per E Crivelli Pp. viii + 321 (Milano Ulrico Hoepli, 1928) 35 lire.

THIS is an interesting book, which can be heartily recommended to makers or users of copper sulphate, to all chemists, and, as regards some sections of it, to the general reader.

Part 1 deals with the development of the blue vitriol industry and with its marketing, methods of analysis and properties, and contains also a detailed description of its manufacture, including treatment of by-products In Part 2, the metallurgy of copper, in so far as it concerns the manufacture of the sulphate, is considered, and in Part 3, such subjects as its physiological effects, its mode of action in lime–copper sulphate pastes, its uses as an anticryptogam, and various minor applications, are discussed

The book has been carefully written and, although the information given must be almost exhaustive, is far from being a mere compilation, the material being dealt with in a logical and readable manner. To the majority of readers, probably the most interesting portions of the book are those of Part 3, in which the available experimental data concerning the effects of copper salts on animals and plants are subjected to critical examination

No index is provided, but this lack is largely compensated for by the table of contents. A few minor misprints occur, and the first logarithm given on page 52 for $CuSO_4$ is actually that of the pentahydrated salt. The printing is of the usual high Hoepli standard

An Atlas of Economic Geography (Text and Maps) By John Bartholomew and Prof L. W. Lyde Third edition, revised and enlarged in co-operation with M R. Shackleton Pp xciii + 74. (London Oxford University Press, 1928) 8*s*. 6*d* net

THIS is more than an atlas of economic geography, for the text runs to nearly a hundred pages, and besides explaining the maps, adds a great deal of useful geographical matter It is full of ideas, and points out many striking geographical correlations. Prof Lyde is responsible for the whole of the text. The number of coloured maps is slightly reduced from the original edition, but two dozen black and white distributional maps have been added. In these, as in the coloured maps, the technique is excellent and the standard of accuracy is high

Minor changes might be made in the map of religions and of commercial development, and it is to be hoped that in the next edition the colour division of the races of man may be abandoned Another improvement in a most useful work would be the re-introduction of the maps of seasonal distribution of rainfall and of languages of commerce.

Stage A Geometry By R W. M Gibbs. (Black's Mathematical Series) Pp viii + 109 (London: A. and C Black, Ltd , 1927) 2*s*

ALL teachers will recognise the importance of the Mathematical Association's Report on "The Teaching of Geometry in Schools," and the value of Mr. Gibbs's work lies in his successful attempt to provide a suitable text-book to cover Stage A as recommended in the Report The arrangement of subject matter and the selection of examples show that the author is used to the practical difficulties of approaching the subject of geometry for the first time

Emphasis is naturally laid on the experimental aspect , and field work, and what is sometimes known as 'boy-scout geometry,' are well treated. In addition to general ideas on mensuration, including Pythagoras's theorem, the book concludes with introductions to symmetry, loci, and similar figures. This volume should form an excellent stepping-stone to the other stages, deductive and systematising, mentioned in the Report

H D. A.

Volumetric Glassware. By Verney Stott. (Books on Glass and Glass Technology.) Pp. 232. (London H F and G Witherby, 1928) 20*s*. net

THIS work comes as a wholesome corrective to those trustful chemists and physicists who are tempted to accept their volumetric instruments even with a modicum of faith. The author emphasises the importance of quality and accuracy in volumetric glassware, and his book is intended for manufacturers and users of such apparatus. Various common types, including measuring flasks, graduated cylinders, pipettes and burettes, are treated in detail, and a description is given of the processes of marking and graduating. Other essential subjects, such as units of volume, calibration tables, and the effect of apparatus errors on results, are also adequately treated The book, which contains numerous illustrations and tables, can be recommended to all who are concerned with volumetric analysis and similar work.

School Researches in Heat By C W. Knight Pupil's Book Pp ii + 96. 1*s*. 3*d*. Teacher's Handbook. Pp. 80. 1*s*. 6*d* net. (London: George Philip and Son, Ltd ; Liverpool: Philip, Son and Nephew, Ltd , n d)

LITTLE books which follow the author's method of teaching heat to an elementary standard by means of questions and answers. They are good in their way, though somehow the spontaneity which the method demands seems dulled by the formality of print

Letters to the Editor.

[T]he Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*]

Nervous Impulse in *Mimosa pudica*.

Is the conduction of the excitatory impulse in the plant essentially similar to that of the nervous impulse in the animal? This problem is of great theoretical interest. In his "Nervous Mechanism of Plants" (1926), Bose states that the intercommunication and interaction between more or less distant organs in the plant are brought about, as in the animal, "in two different ways—by translocation of matter and by transmission of motion. The first is effected by the *slow* movement of fluid carrying chemical substances in solution, such as occurs in the circulation of sap; the second by the *rapid* propagation of protoplasmic excitation such as the nervous impulse in the animal." In his presidential address at the Indian Science Congress, Lahore (1927), Bose makes his position perfectly clear by the statement that in physiological investigations the inquirer is primarily concerned *with the function of the organ and not with its outward form.* In support of this he adduces the case of insectivorous plants (*Drosera*, *Dionæa*, and *Nepenthes*) which are universally acknowledged to possess digestive organs, in spite of the fact that the organs are very different in appearance from those of the more complex animal. The employment of the same term for these plant and animal reactions is justified by the fact that the function of digestion is performed by similar processes in both: the solution of organic food-material by a glandular secretion, and the subsequent absorption of the dissolved product.

The plant-world offers a unique opportunity for the study of the gradual evolution of a simple and primitive organ into one of greater complexity. In regard to the nervous function, it is to be remembered that the conducting tissue in the animal kingdom itself exhibits wide variation: from the simpler type as in the Medusæ to the more complex in the higher animals. The conducting tissue of the plant would naturally be expected to be much simpler in structure, and as a matter of fact it is very different in appearance from the nerve of the higher animals. The question to be decided is whether or not the process of conduction of excitation is similar in the two cases (being usually detectable by the contractile movement of the terminal motor organ).

There are several physiological tests of a crucial character by which the nature of the transmission of the impulse in *Mimosa* can be ascertained; whether it is dependent upon a movement of sap, or is a conduction of protoplasmic excitation. Sir J. C. Bose has been kind enough to offer me every facility for working in his Research Institute at Calcutta, and an account of the following experiments on transmission of excitation in *Mimosa* will doubtless be of interest to readers of NATURE. It may be stated that the series of experiments which I repeated were accomplished without a single failure. Limitation of space allows me to describe only one typical example of each series.

The experiments were carried out in winter (January 1929). Though the physiological condition of *Mimosa* was not so favourable as in summer, yet I encountered no difficulty in obtaining the following results in a green-house (temp. 30° C.) in which the sunlight was uniformly diffused by glass thinly coated with white paint.

EXPERIMENTAL SERIES 1. *Discriminative Polar Action of Electric Current in Excitation.*—In an animal nerve, a feeble electric current initiates excitation at the cathodic point at 'make' (there being no excitation at the anode), the transmitted excitation is detected by the twitch of the terminal muscle.

In the parallel experiment with *Mimosa*, I made suitable electric connexions with two opposite petioles at a distance of 20 mm. from the motile pulvinus. When the point on the right petiole was made the cathode, an excitatory impulse was generated which, travelling against the direction of the normal transpiration current, reached the pulvinus and caused the fall of the leaf after an interval of 1·5 sec. Making allowance for the latent period of the pulvinus, the velocity of transmission of excitation in this winter specimen was found to be 14·3 mm. per second. Reversal of the direction of the current by a Pohl commutator caused cathodic stimulation of the left petiole, resulting in the fall of that leaf.

Similar results were obtained with the secondary petiole of a leaf, in which the propagation of the excitatory impulse is exhibited by the upward closure of the sensitive leaflets (Fig. 1). Bose found that the

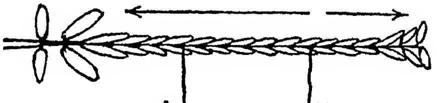

FIG. 1.—Effect of feeble current. *K*, cathode: excitation transmitted across feeble anode *A*. Arrows indicate directions of propagation of impulse which ultimately causes closure of all leaflets to right and left.

velocity of transmission in *thin* petioles is very much higher, being 100-350 mm. per second. My results fully confirm this.

It will be noted (1) that the impulse was transmitted in the complete absence of any hydromechanical disturbance; (2) that excitation was originated and conducted without any wound which might have induced the secretion of some hypothetical stimulant which could be translocated by the movement of sap; (3) that the direction of transmission of impulse was inwards, against the direction of the normal transpiration current; (4) that the speed of transmission was incomparably higher than that of the slow movement of sap; and (5) that the characteristic polar action of the current which initiates nervous impulse in the animal also caused an excitatory impulse in the plant.

EXPERIMENTAL SERIES 2. *Arrest of Conduction by Anodic Block.*—With feeble current, the impulse in the animal nerve is transmitted across the anode, but with a stronger current, the depression of conductivity at or near the anode is so great that the impulse is arrested by an anodic block.

In *Mimosa*, parallel effects can easily be demonstrated in the secondary petiole, conduction taking place in both directions as in the nerve. On starting a feeble current (1·4 microamperes), the cathodic excitation at *K* was transmitted (Fig. 1) to the right and to the left (across the feeble anode). The experiment was repeated with a stronger current (3·5 microamperes); the impulse initiated at the cathode *K'* was now transmitted to the extreme right end of the secondary petiole; whilst the impulse to the left was

completely arrested at A' by the depression of conductivity caused by the stronger anode (Fig. 2).

EXPERIMENTAL SERIES 3. *The Reflex Arc.*—The phenomenon of the reflex arc is well known in the animal, where the afferent or ingoing impulse due to peripheral stimulation is reflected at a centre and is transmitted along a new path as an efferent or outgoing impulse

It is very surprising that exactly parallel effects are observable in *Mimosa* Peripheral stimulation of the

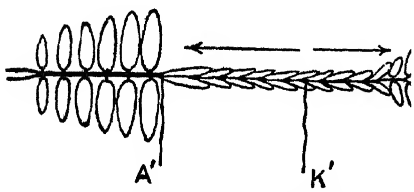

FIG 2 —Effect of stronger current Block at stronger anode A'

secondary petiole (1) at S, by tetanising electric shock of moderate intensity (Fig 3), gives rise to an ingoing or afferent impulse, which reaches the pulvinus and causes the fall of the leaf. After a short while, the existence of an efferent or outgoing impulse is detected by the serial fall, from base towards apex, of the leaflets on the secondary petiole (2) There is a marked difference between the velocities of the ingoing afferent and of the outgoing efferent impulses Bose found it to be about seven times greater. In the experiments which I carried out I found it to be six to eight times quicker

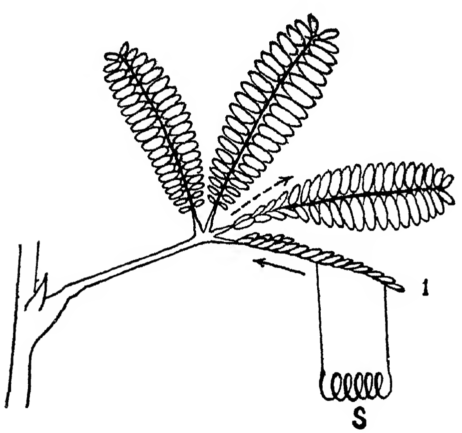

FIG 3 —The reflex arc Peripheral stimulation of secondary petiole 1 at S causes afferent impulse (continuous arrow), which after reflection at pulvinus gives rise to efferent impulse (dotted arrow) in secondary petiole 2

As all the characteristic effects of the transmitted impulse in *Mimosa* are in every way similar to those of the nervous impulse in the animal, the most natural inference is that the process of transmission is of the same nature in both Physiologists will therefore be inclined to agree with Bose's conclusion, that if the impulse be called 'nervous' in the animal, there is equal reason for applying the same term in the case of the plant.

HANS MOLISCH

Bose Institute, Calcutta,
Jan 29

Growth-gradients and the Development of Animal Form.

D'ARCY THOMPSON in his "Growth and Form," Chapter xi., deals lucidly with the properties of logarithmic spirals, and the reasons for their frequent occurrence in organisms. He points out that for them to arise, (1) parts of the growing edge must be growing at different rates, the growth-rates of any two points on the edge preserving a constant ratio of growth-rates for so long as a regular logarithmic spiral is produced, (2) the growth-rate must fall off more or less steadily from one end of the growing surface to the other, (3) the products of growth must be laid on as so much dead matter, or at least matter incapable of further growth. In his own words (p. 500) the logarithmic-spiral form of an organic structure can be explained "if we presuppose that the increments of growth take place at a constant angle to the growing surface, but more rapidly at the 'outer edge' than at [the 'inner edge'], and that this difference of velocity maintains a constant ratio. Let us also assume that the whole structure is rigid, the new accretions solidifying as soon as they are laid on."

It is, I think, worth pointing out that this and the type of growth which Champy (C. Champy, "Sexualité et Hormones," Doin, Paris, 1924) and I (J S. Huxley, *Biol. Zentralblatt*, Bd 47, p. 151, 1927) have called heterogonic (in which the size-relations of organs x and y can be represented by the equation $y = bx^k$) are both special cases of the same phenomenon, namely, of constant differential growth-ratios in different regions of the organism The sole difference is that in logarithmic-spiral growth the increments produced take no further part in growth, but are locked up as so much rigid structure, while in heterogonic growth the increments are added to the mass of living tissue capable of continued growth. The difference is similar to that between two sets of sums of money growing at different rates of simple interest and at different rates of compound interest respectively.

There is a further interesting similarity between the two types of differential growth. In logarithmic-spiral growth, the growth-rates fall off more or less evenly from one margin of the growing surface to the other. I have succeeded in showing (*l.c.* and unpublished work) that in markedly heterogonic organs such as crustacean chelæ (*Uca, Maia, Homarus, Eupagurus*, various prawns, etc.) the most rapid growth-rate is that of the penultimate joint, the growth-rates of the other joints falling off regularly as the body is approached. Similar facts appear to be true for the limbs of ungulates, according to my friend Mr. J. C Hammond, and the abdomen of female spider-crabs (M. E. Shaw, *Brit J Exp. Biol.*, 6, 145, 1928). When, on the other hand, growth is isogonic, all the parts (joints of female chela, *Uca, Maia*, joints of male abdomen, *Inachus*) grow at the same rate.

As I previously pointed out, and as has been stressed by Pearsall (W H Pearsall, "Growth Studies." 6. "On the Relative Sizes of Growing Plant Organs," *Ann. Botany*, vol. 41, No 163, pp. 549-556; 1927) in his analysis of similar heterogonic relations between the parts of plants, heterogony is really the simplest type of differential growth, occurring, namely, when the ratio of two growth-rates remains constant over long periods. It is interesting to find that one of the other most generally distributed modes of growth, that in the form of a logarithmic spiral, is deducible from the same principle. Various shells depart slightly from the strict logarithmic spiral; and various disharmonically-growing organs depart slightly from the accurate heterogonic formula. But this does not obscure the basic nature of the differential growth-ratio.

It would further seem to be a general principle that when two regions of markedly different growth-rate exist in an organ or region, there is a graded change of growth-rate in the intermediate space. The biochemical basis of such graded differences in growth-rate should be interesting to investigate.

JULIAN S. HUXLEY.

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April 3

Difference between the Absorption and the Raman Spectrum.

SEVERAL investigators have recently stated that in many cases Raman lines are found which do not correspond with infra-red absorption frequencies (Carelli, Pringsheim, and Rosen, *Zs. f Phys*, **51**, p 511, 1928: Czerny, *ibid.*, **53**, p. 317; 1929: McLennan and McLeod, NATURE, **123**, p. 160, 1929: Ellis, *ibid*, p. 205: Rasetti, *ibid.*, 205: R. W Wood, *ibid.*, p. 279, and others) Several authors state this as contrary to the theoretical expectations. The purpose of this note is to direct attention to the fact that the above-mentioned phenomena, far from being a contradiction to the theory, really furnish a very good proof for the validity of the Kramers' theory of dispersion, which includes the theory of the Raman effect.

If we consider two levels A_1 and A_2 we have absorption if the transition coefficient a_{12} is different from zero But this coefficient does not enter at all into the expression which determines, according to Kramers and Heisenberg, the intensity of the Raman line. From the fact that this coefficient is zero, one cannot therefore conclude that the corresponding Raman line must be absent and vice versa. The intensity of the Raman lines is determined by the transition coefficients to levels B_1, B_2, B_3, etc, which can combine with both A_1 and A_2. The Raman frequency can therefore always be regarded as the difference between the frequencies of two lines, one of which must be an absorption line, and this in agreement with the results of Rasetti and especially with those of McLennan and McLeod. A very good example is also furnished by the beautiful results of Wood in hydrochloric acid. Wood finds that the so-called missing line occurs with great intensity in the modified radiation, whereas the real lines of the absorption band are faint and doubtful.

This is exactly what we must expect. For let us consider a hydrochloric acid molecule in a definite rotational state j, and confine ourselves to the different vibrational and rotational states of the normal molecule Then there is, on account of the selection rule for j, not a single state which can combine at the same time with the j and the $j \pm 1$ rotational state, or differently expressed, an absorption line of the HCl band cannot be written as the difference of two other lines and therefore ought not to occur in the Raman spectrum. On the other hand, every transition in which the rotational quantum number j does not change or varies two units (the *vibrational* quantum number varies from zero to one for all lines under consideration) can be written in more than one way as a difference of two line frequencies. We must, therefore, expect these frequencies in the Raman spectrum rather than the frequencies of the absorption band. The transitions in which j does not change give the 'missing line' and are forbidden as absorption lines. Raman lines corresponding to transitions $j \longrightarrow j \pm 2$ must be expected very much weaker, as they are distinct lines for different values of j with twice the distance of the absorption lines, whereas all the $j \longrightarrow j$ transitions correspond to lines which coincide on the place of the zero line and give rise, therefore, to one intensive line. This seems to be in agreement with Wood's observations. Rotational transitions $j \longrightarrow j+2$ of the expected type seem to have been observed by McLennan and McLeod in H_2. If also the ultra-violet absorption bands, of which nothing is known, are taken into account, these considerations have to be modified a little. But from the general structure of the molecular terms it can be deduced that, for diatomic molecules at least, an absorption line never can be expected as a Raman line Apparent exceptions to this rule find their explanation in an unresolved fine structure

With the same considerations one sees that scattering in sodium vapour ought to give a shift corresponding with the forbidden line $1s-2s$ rather than with the absorption line $1s-2p$

Since the above was written, I have seen the letter by Langer in NATURE of Mar. 9, p. 345, in which he makes essentially the same observation. But as he treats only a rather complex example and proceeds according to somewhat different lines of reasoning, the present note is perhaps not superfluous. It ought to be mentioned also that Schrodinger's theory of dispersion in its original form is, contrary to Langer's statement, not in agreement with the facts, whereas the present form of quantum mechanics (Dirac) leads exactly to Kramers and Heisenberg's results.

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Holland, Mar. 8.

Breeding Habits of the Greenland Whale.

VERY little is known about the breeding habits of the Greenland whale. In the Greenland Sea, according to the log-books of Scoresby Sen., females with calves with them were seldom seen except in spring, west of Spitsbergen, north of latitude 78° or 79°, and in the end of July off the Greenland coast. Young whales, with whalebone 2-3 feet long—the smallest which are seen by themselves—were also seldom seen except in a high latitude west of Spitsbergen in spring. Where they go to in the summer months is not hard to understand: as my father says, "the old females with the younger whales of both sexes bury themselves in the polar ice, north of latitude 80°, after (or before) the end of June, where no ship can follow them, retreating in the autumn southwards as the ice makes in the north" (Scottish Fishery Board, Seventh Annual Report, part 3, p 366).

A female with a calf with it became a rare sight in the Greenland Sea, in twelve voyages (1791–1798, 1801, 1817, 1820, and 1822) Scoresby Sen. saw one only on sixteen dates, namely, west of Spitsbergen, and north of 78° or 79° in April once, in May eleven times, and in June once; and off Greenland twice, both times at the end of July, in latitude 70°; in the forty-four voyages he was master (1849–1891 and 1893) my father only saw about a dozen (*l c.*, p 365), and in his last twenty voyages only one (in the end of July in latitude 73° off the Greenland Coast), and in the log-books of twenty-nine other voyages made in the period 1872–1908 not a single instance is recorded.

There are few facts to go on, but it seems safe to infer from what the Scoresbys and from what Eschricht and Reinhardt say, that at least some of the young are produced in the spring. Even less is known about where they produce, at one time they entered the inlets of western Spitsbergen in the summer months, and Sir Sidney Harmer (*Proc. Linn. Soc.*, May 1928, p. 89) connects their visits with the function of

parturition and looks on the unmolested use of the Spitsbergen bays as of importance to them; this, however, seems unlikely for the following reasons:

1 In the spring, when some, possibly all the whales of the species, as Scoresby suggests, produce their young, the sheltered parts of the west Spitsbergen inlets are usually still covered with the ice that forms in the winter months.

2. In Davis Strait, according to Eschricht and Reinhardt, the corresponding visits of the species to the inlets of west Greenland synchronised with the proximity of the pack-ice to the coast and were not connected with parturition.

3. In the Greenland Sea and in the waters west of Spitsbergen (the 'Greenland' of the old whalers), contrary to what Sir Sidney Harmer states (*l c*, p. 59), the fishery continued productive for long after the whales ceased to enter the inlets and bays; in the ten seasons (1679–1688) (thirty or forty years after) the 'Greenland' fleet of the Dutch, numbering about 190 ships, alone captured 10,019 whales (Scoresby, vol. 2, p. 156), and so late as 1814 in the same waters 76 English and Scotch 'Greenland' ships alone captured 1413 in a single season (*ibidem*, p 121).

Sir Sidney Harmer seems to imply that the females with calves with them not only entered the Spitsbergen bays, but also were destroyed in these situations in large numbers by the early whalers, this, again, seems unlikely, for in the seventeenth century the whalers do not appear to have arrived at Spitsbergen until the end of May, and after the time at which the females with calves with them usually disappear amongst the impenetrable polar ice, a separation of the sexes seems to take place in the summer months, and it seems more likely that the whales that entered the Spitsbergen bays and were killed by the early whalers (if they all belonged to this species) belonged mostly to the male sex ROBERT W. GRAY.

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Nuclear Levels and Artificial Disintegration.

THE existence of quasi-discrete levels in the atomic nucleus has been suggested by Dr. Condon and myself in a paper in the *Physical Review*, in which the nuclear theory first outlined in NATURE, Sept. 22, 1928 (vol. 122, p 439), is pursued. These quasi-discrete levels are narrow ranges of energy for which the amplitude of the ψ-functions inside the nucleus is large compared with the amplitude outside. In a very interesting letter in NATURE of Nov. 24, 1928, G Gamow, who in other respects had arrived quite independently at the same basic ideas with regard to the nucleus (*Z. f. Phys*, **51**, 204), gave a résumé of various applications, including that of artificial disintegration, a detailed account of which has since appeared (*Z. f Phys.*, **52**, 510). Considering the intensities of the transmitted and reflected waves, he inquires how the probability of penetration into the nucleus will fall off with decreasing velocity of the incident α-particle, treating the nucleus as a simple potential barrier, he naturally finds that the probability shows a steady decrease.

The object of the present note is to direct attention to the possibility of resonance phenomena if we take into account the solutions of the Schrodinger equation which for certain ranges of energy give ψ-functions the amplitude of which inside the nucleus is large compared with that outside For this seems to indicate that variation of the velocity of the incident α-particle may be accompanied by an enormous fluctuation in the probability of penetration when the energy approaches and enters the range of energy corresponding to one of the possible quasi-discrete levels. A systematic examination of thin films of various elements might disclose such a fluctuation, if the experimental difficulties can be overcome. No resonance effect would be possible if we had discrete levels, indefinitely narrow; the absence of any genuine quantisation in the nucleus is due to the fact that the potential energy of the α- or β-particle must be taken as tending to zero when distant from the nucleus, in contrast to the method of Laue; it would seem, then, that the *Eigenwerte* of which he speaks (*Zeit f. Phys.*, **52**, pp 731-2) do not exist, but that all energies are possible (a continuous spectrum).

The transmission of particles through a simple potential barrier resembles transmission of light at a single reflecting surface, in that the coefficient falls off steadily with varying wave-length. But it is of course well known that the addition of a second reflecting surface (as in Fabry and Perot parallel plates) causes large fluctuations in the transmission, those wave-lengths being favoured for which standing waves are possible, that is, when the thickness of the film is equal to one or more half-wave-lengths. This provides a crude analogy to the case of the nuclear ψ-functions, one half-wave-length for a free swift α-particle being about $2{\cdot}5 \times 10^{-13}$ cm. Possibly the discovery by Rutherford and Chadwick of an energy giving minimum intensity of reflection of α-rays at 135° (*Phil Mag.*, **50**, p. 900, 1925) was a resonance phenomenon.

The application of the quantum mechanics may modify the interpretation, but seems to throw no light on the origin of the discrepancies between the results obtained at Cambridge and Vienna. Although, for example, the argument in favour of a theoretical minimum range for the ejected H-particles has lost its validity, since they may now escape through the potential barrier instead of having to fall through the entire repulsive field as had been previously argued by Chadwick (*Phil. Mag.*, **2**, pp 1073-4; 1926), the experimental observation remains unaffected.

RONALD W GURNEY.

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The Average 'Forward' Momentum of Photoelectrons.

IT is well known that the emission of photoelectrons by X-rays is not symmetrically distributed about the plane normal to the rays, the photoelectrons possessing an average momentum in the 'forward' direction. I showed about a year ago (NATURE, Jan. 28, 1928, p. 134) that, contrary to general supposition, the average forward momentum, μ, of a photoelectron is, according to experiment, not equal to the momentum $h\nu/c$ of an incident quantum, but is appreciably greater. Sommerfeld in his recently published book, "Atombau und Spektrallinien, Wellenmechanischer Erganzungsband" (1929), has treated the problem theoretically by the wave mechanics, and the purpose of the present note is to show the remarkable agreement of Sommerfeld's result with experiment.

Sommerfeld (p 218) finds that the probability $P(\phi).d\phi$ of emission of a photoelectron at an angle between ϕ and $\phi + d\phi$ with the incident radiation is proportional to

$$\{1 + \tfrac{18}{5}\sqrt{(h\nu/mc^2)} \cos \phi\} \sin^3 \phi \,.\, d\phi \qquad (1)$$

It follows from this that the average momentum of a photoelectron is

$$\mu_{\text{theor}} = 1{\cdot}44(h\nu/c). \qquad (2)$$

The value found experimentally by Nuttall Barlow

and myself (*ibid.*, also *Proc Roy. Soc*, December, 1928) is

$$\mu_{\text{expt}} = 1\cdot 40(h\nu/c) \quad . \quad (3)$$

If $\overline{\cos\phi}$ denotes the mean cosine of ϕ, θ the 'bipartition' angle (defined by $\int_0^\theta P(\phi)d\phi = \int_\theta^\pi P(\phi)d\phi$), and ρ the ratio of the forward to the backward emission, then according to (1)

$$2\,\overline{\cos\phi}/\beta = 1\cdot 44,\ 2\cos\theta/\beta = 1\cdot 80,\quad 2(\rho-1)/(\rho+1)\beta = 2\cdot 70 \quad . \quad (4)$$

β being the velocity of the photoelectron relative to that of light. The observed values of these quantities are 1·4, 1·8, and 2·6 respectively. Thus there is very good agreement with experiment whatever quantity is chosen as a measure of the asymmetry.

Formula (1) expresses the asymmetry to a first approximation, and is applicable only if $(h\nu/mc^2)$ and $(J/h\nu)$, where J is the binding energy of the electron, are small These conditions are adequately satisfied in the cases investigated in the above experiments, namely, photoelectrons produced in nitrogen and oxygen by X-rays of wave-length 0·6 A.

Mention should be made of P Auger's recent experiments in which he finds $\mu = 1\ 30(h\nu/c)$ for argon and $\lambda = 0\cdot 21$ A, and $\mu = 1\cdot 30(h\nu/c)$ for argon and $\lambda = 0\cdot 71$ A. (*Comptes rendus*, Dec. 10, 1928). These results and (3) show that $\mu/(h\nu/c)$, equals σ say, is approximately independent of λ and J as is required by (2). As mentioned in the previous paragraph, formula (1) represents the asymmetry only to a first approximation, and theoretically there should be a small variation of σ with λ and J which may account for the slightly smaller values of σ found by Auger. Auger's earlier observations (*Jour. d. Phys.*, February 1927) quoted by Sommerfeld correspond to $\sigma \doteqdot 0\cdot 9$, but this is refuted by his recent experiments.

Sommerfeld states that his calculated asymmetry is 9/5 times that expected on simple light quantum theory, but if we consider the mean momentum of the photoelectrons instead of the bipartition angle as Sommerfeld does, the ratio is $\frac{4}{5} \times \frac{9}{5} = 1\cdot 44$, as expressed by (2) The difference arises from different ways of regarding the simple light-quantum theory and is unimportant.

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Cambridge, Mar. 6

Anomalous Terms in the Spectrum of Doubly Ionised Lead.

In the course of an analysis of the spectrum of doubly ionised lead (Pb III), the results of which will shortly be published, some combinations of more than usual interest to spectroscopists were found to occur. These combinations involve the anomalous terms arising from the state of the doubly ionised atom of lead when both the two remaining valence electrons occupy $6p$ orbits. The terms to be expected for this state of the atom are $6^3\bar{P}_{012}$, $6^1\bar{D}_2$, and $6^1\bar{S}_0$.

As is well known, the rules for the transitions between states of an atom with two valence electrons are that $\Delta l_1 = 0$, $\Delta l_2 = \pm 1$, or $\Delta l_1 = \pm 1$, $\Delta l_2 = \pm 2$ where l_1 and l_2 are the azimuthal quantum numbers of the two electrons. Accordingly transitions from the $6p6p$ state to the following low-lying states may be expected to occur: $6p6d$, $6p6s$, $6d6f$, $6s6f$. The second and fourth of these states lead to the important low-lying terms 6^3P_{012}, 6^1P_1, 6^3F_{234}, and 6^1F_3. Applying the inner quantum number selection rules, we obtain between these terms and the anomalous $6^1\bar{D}_2$ term the following possible combinations · $6^3P_{12} - 6^1\bar{D}_2$, $6^1P_1 - 6^1\bar{D}_2$, $6^1\bar{D}_2 - 6^3F_{23}$, and $6^1\bar{D}_2 - 6^1F_3$.

All these combinations have been found λλ995 75, 1165·05 form the doublet $6^3P_{12} - 6^1\bar{D}_2$, and λλ4004·16, 3925 23 the doublet $6^1\bar{D}_2 - 6^3F_{32}$, λλ1439·42, 3832 83 are $6^1P_1 - 6^1\bar{D}_2$ and $6^1\bar{D}_2 - 6^1F_3$ respectively. The measures below 2000 A are by Dr R. J. Lang and are expressed in λI A vac, and those above 2000 A are by myself and are expressed in λI.A air. The source in each case was the vacuum spark

It may be recalled that Sawyer (*Jour Opt Soc. America*, **13**, p 431, 1926) in the case of the arc spectrum of zinc, classified a doublet as arising from combinations between the 4^3P_{12} terms and an anomalous $4^1\bar{D}_2$ term. But so far as I am aware there have as yet been no cases recorded of the appearance of $F\bar{D}$ combinations for two valence electron systems. For this reason the $F\bar{D}$ lines mentioned above are of peculiar interest

Of the three terms $6^3\bar{P}_{012}$, only $6^3\bar{P}_1$ has been found This apparent absence of the $6^3\bar{P}_{02}$ terms is in agreement with the known facts regarding the corresponding terms of Zn I, Ca I, and Hg I The line λ2868·16 is also worthy of notice, as it appears to be $6^3\bar{P}_1 - 6^3F_2$, a combination which is also to be expected It is of course the only combination between the F terms and the $^3\bar{P}_1$ term permitted by the inner quantum number transition rules. The $6^1\bar{S}_0$ term has not yet been determined. Unfortunately, only the combinations $6^3P_1 - 6^1\bar{S}_0$ and $6^1P_1 - 6^1\bar{S}_0$ are to be expected There is at least one likely pair having the $6^3\bar{P}_1 - 6^1P_1$ separation, but the absence of confirmatory evidence in the form of further combinations makes it difficult to come to a definite decision.

The first spark spectrum of thallium (Tl II), which is analogous to that of Pb III, has also been investigated and the $6^3P_{12} - 6^1\bar{D}_2$ and $6^1P_1 - 6^1D_2$ lines have been found. The $F\bar{D}$ combinations would give rise to lines lying far in the infra-red, and consequently have not yet been identified.

Stanley Smith

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Agricultural Education.

The leading article in Nature of Mar. 9 on "Land and Industry" indicates an interesting possibility of dealing with the unquestionably important problem of establishing a 'land interest' among non-agricultural citizens It might be worth while to consider the relation of agricultural education to this problem.

No one who has seriously considered the problem of national agricultural prosperity is likely to deny that the interest of the city and urban public is a primarily important factor. Nor is he likely to deny that those of us who are responsible for developing interest in agriculture have practically ignored the non-agriculturist The activities of agricultural education have increased enormously during the last quarter of a century, but it seems to have been tacitly assumed throughout its developments that agricultural education is essentially and almost exclusively a provision for agriculturists, and that for the most part the proper people to exercise primary control over it are agriculturists and not educationists

I have an ever-increasing conviction (confirmed to no small extent by Mr. C. G. T. Morison's presidential address to the Agriculture Section of the British Association in 1927) that agricultural education can render a far greater service to the country if it will remove its delimitations and endeavour to attract

others than intended agriculturists If our university departments of agriculture would open their doors wider and offer courses for laymen as well as for agriculturists, and regard such courses as equally important, the ultimate development of a 'land interest' would surely be considerable If men and women who are destined to teach in our schools or to take a part in public affairs had the opportunity to read agriculture during a university course, the ultimate indirect effect on our national agriculture might be as great as the present direct effect of agricultural education

So far as its direct influence on farming practice is concerned, agricultural education is normally associated with some such phrase as "the application of science to farming" When, however, one considers the two great groups of factors which alone can create or alter an economic condition—scientific facts and philosophical outlook—one is left with more than a suspicion that the greater defect in our agriculture is not in science but in philosophy Great as is the scope for bringing more scientific knowledge to the farm, the limiting factor to-day is interest in farming and in the phenomena of the farm. Without slackening its efforts to find scientific solutions of specific farm problems, agricultural education can greatly increase its service to the community by giving more attention to what after all is the essence of education, namely, the development and propagation of an interest in its subject matter

This suggestion in no way implies a criticism of the work of those agriculturists who, for the most part, control the administration of agricultural education in Great Britain The suggestion is rather that their work needs to be balanced by purely educational aspects of the teaching of agriculture in order that agricultural education may be developed with properly distributed emphasis and with greater usefulness to the community. N M. COMBER

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The Occurrence of Ergosterol in Phytosterols.

THE interest which has been aroused by the discovery that ergosterol is converted into vitamin-D on irradiation has led us to consider its possible mode of formation in the vegetable kingdom.

In this connexion some interesting facts arise from the recent work of Bonstedt (*Zeitschr. fur physiol. Chem.*, **176**, 269 ; 1928) on γ-sitosterol, first detected by Anderson and Shriner in corn oil (*Jour. Am. Chem. Soc.*, **48**, 2976, 1926). This investigator has prepared a number of derivatives of this sterol, and a comparison of their physical properties with those of the isomeric derivatives in the ergosterol series reveals, as shown in the following table, a remarkable similarity :

Formula	Substance.	m p (α)D.	Authority
$C_{27}H_{48}O$	γ-sitostanol	143-4° +21°	Bonstedt (*loc cit*)
	,,	144-5° +18°	Anderson, Shriner (*loc cit*)
	allo-α-ergostanol	144-5° +16°	Reindel and Walter, *Annalen*, **460**, 212, 1928
$C_{29}H_{50}O_2$	γ-sitostanol acetate	144-5° +12°	Bonstedt
	γ-sitostanol acetate	143° +9°	Anderson, Shriner
	allo-α-ergostanol acetate	145° +6°	Reindel, Walter
$C_{27}H_{46}O$	γ-sitostanone	163° +38°	Bonstedt
	allo-α-ergostanone	164° .	Reindel, Walter
$C_{27}H_{48}$	γ-sitostane	87° +20°	Bonstedt
	allo-α-ergostane	84-5° +17°	Reindel, Walter.

Reindel and Walter (*loc. cit.*) have shown that there is no depression of melting-point on mixing γ-sitostanol acetate with allo-α-ergostanol acetate, but infer from the difference in specific rotation that the two substances are not identical. This contention we feel is open to question, for, as we have already pointed out (Heilbron, Morton, and Sexton, *Jour Chem Soc.*, p. 47, 1928), owing to the complex nature of the sterol molecule, the possibilities of racemisation at one or more of the asymmetric centres during the operations involved in their preparation cannot be excluded.

The common and probably general association of dihydrositosterol with sitosterol in vegetable oils (*see* Bonstedt, *loc. cit.*, Anderson *et alia*, *Jour. Amer. Chem Soc.*, **48**, 2972 *et seq.*; 1926) suggests its genesis by a reduction process Similarly, as there is every reason to believe that ergosterol is also present in all phytosterols (Heilbron, Kamm, and Morton, *Biochem. Jour.*, **21**, 1279, 1927), we venture to suggest with all reserve that concurrent with its reduction to dihydrositosterol (sitostanol), oxidation of sitosterol (possibly γ-sitosterol) to ergosterol occurs.

The fact that neither of the two known tetrahydroergosterols (ergostenols) is identical with the isomeric γ-sitosterol is in no way remarkable. It has been established that ergosterol contains an ethenoid linkage which resists hydrogenation under conditions which suffice to convert γ-sitosterol into the fully saturated derivative, consequently, in the conversion of ergosterol to its tetrahydro derivative, the ethenoid linkage remaining must be in a different position from that present in γ-sitosterol. The suggested identity therefore only reveals itself in the fully saturated products.

It is hoped that work which is now in progress in these laboratories may throw additional light on this important problem. I. M HEILBRON.
W A. SEXTON.

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Transmutation of the Lighter Elements in Stars.

THE formula given by Gamow (*Zeits. f. Phys.*, **52**, p. 512, 1928), for the probability that an α-particle will penetrate the nucleus of an atom with which it collides, can be readily adapted to the case of proton-impacts. These have only half the charge of an α-particle, and for the same energy twice the velocity, so that under conditions approaching thermodynamical equilibrium they have an enormously greater penetrating-power. We have investigated the possibility that in the interior of stars the process should actually occur with appreciable frequency, and we find that for the heaviest elements the probability is extremely small For the lightest, however, we obtain an average life varying roughly from 10 seconds for helium to 100 years for carbon in a fairly typical case. The protons that are most effective, when their number is taken into account, are those with from three to four times the most probable velocity of the Maxwell distribution.

We cannot well estimate the probability that a proton which has entered a nucleus will anchor itself there by radiating, but there are some indications that it may be high. In that case there is an obvious possibility of gradually building somewhat heavier elements out of the lightest ones ; this possibility is much improved if *electrons* can also penetrate the nucleus, but the calculation of this case has not yet proved practicable. It seems, however, a plausible assumption. We may then expect that the isotope Be^8 will be one of the products ; this is probably unstable (it does not occur on the earth), and will then almost certainly break up into two helium-nuclei, so that the supply of helium does not become exhausted, and the process

is limited only by the amount of hydrogen. The theory obviously contains several uncertain hypotheses, but a calculation of the amount of energy that would be set free by the process gives quite the right order of magnitude. In addition, the process fulfils the requirement of Eddington that its probability should increase very rapidly with the temperature at about 40 million degrees, and can also fulfil his requirement that it should contain a 'delay-period' which is not dependent on temperature or pressure. It thus seems possible that the stellar energy has a source in this method of element-building which the wave-mechanics has opened up to us. But there are so many astrophysical difficulties that we hesitate to express a definite opinion, more especially as it is difficult to see how the heaviest elements can be formed by this means at all.

A full account of the investigation will appear shortly in the *Zeitschrift fur Physik*. It would seem worth while to investigate the effect of fast protons on light elements in the laboratory, and experiments along these lines are contemplated.

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Mar. 22.

Internal Absorption of γ-rays.

FOUR years ago (NATURE, 115, 13, 86, 1925), one of us estimated the internal absorption of the γ-rays of radium-D and the fraction of the atoms emitting γ-rays. Due to an oversight and, in the latter case, an arithmetical error, both estimations are incorrect. They have recently been re-calculated in the following manner

The relative ionisations produced by the β-rays of radium-E (in equilibrium with the radium-D), and the soft and hard γ-rays were measured in an electroscope, the walls of which consisted of paper coated with graphite and, after correction, were found to be 24,000, 40, and 2 6 respectively. Assuming that the energy in a beam of X- or γ-rays is proportional to the total ionisation produced in air, the respective energies in the three types of rays were found to be proportional to 1500, 13, and 23. As the respective average energies of single rays are 350,000, 12,000, and 46,700 electron volts, we find that for the disintegration of 43 atoms of radium-E or radium-D, 11 atoms emit a soft γ-ray (L-radiation) and 5 atoms a hard γ-ray. No allowance, however, has as yet been made for the fact that β-rays are ejected by the hard γ-rays from M and N levels (the consequent M and N radiations would not be observed in our experiments). Curtiss estimates that the intensity of the β-rays ejected by the hard γ-rays from the M and N levels is 70 per cent that from the L levels, so that, assuming the number of hard γ-rays absorbed to be proportional to these intensities, 8 atoms emit M and N radiations

We arrive, therefore, at the following figures. Out of 43 atoms disintegrating, 24 atoms emit γ-rays. Of these 24 γ-rays, 19 suffer internal absorption. It seems probable that, in the case of all substances, only a fraction of the atoms emit γ-rays after a β-ray disintegration. This should be taken into account in estimating times of emission of γ-rays

A further set of experiments was carried out to determine if there were any β-rays emitted from radium-E with energy of the order 2,000,000 electron volts. The method used may be of interest and is given below. An electroscope was placed on top of the poles of an electromagnet, which produced an average field of 1250 gauss. The active material was 10 cm. below the bottom of the electroscope Sufficient material was placed beneath the electroscope to cut off secondary β-rays produced by γ-rays, and, directly over the active material, absorption sheets which cut down β-rays of energy 2,000,000 volts until the issuing rays had a value of $HR < 6000$ Such rays would be deflected from the electroscope by the magnetic field. No difference was found between the electroscope readings with and without magnetic fields Allowing for the difficulty of measuring small differences, we estimate that less than one atom in 25,000 emits a β-ray of energy 2,000,000 volts, and possibly none at all.

J A. GRAY.
A J. O'LEARY.
Queen's University, Kingston,
Feb. 7

Diœcism in *Ranunculus acris*.

MR. R. O WHYTE's letter in NATURE of Mar 16, p 413, on the cytological aspect of the hitherto little noticed peculiar form of the common acrid buttercup, stimulates me to make some general remarks respecting it.

I first made its acquaintance in the spring of 1923 near my home in Cumberland, and sent specimens to the Linnean Society of London. They were exhibited at the meeting held on June 21 (*Proc Linn Soc*, p 50, 1923) Through lack of time, I believe, they were not discussed. I then approached a leading authority on the British flora, Dr. Claridge Druce, who kindly replied to the effect that this form was strange to him. He incorporated it in his "Plant Notes" for 1923 (*Report*, Bot. Exchange Club, p 24, 1923), with an extract from my letter, naming it *Ranunculus acris* L. var ; sub. var , or forma *minutiflorus*, Druce

Finding that Mr Marsden-Jones was working on the genetics of the genus *Ranunculus*, I sent specimens to him, and he was not long in reporting to me the occurrence of the same in his own neighbourhood, Potterne, Wilts. I am glad to see that he has not only taken up the genetics of it, but also has prevailed upon Mr. Whyte to work out the cytological side—a piece of research which promises to shed light on the origin of unisexual from hermaphrodite flowers

It is curious that this 'female' form of *Ranunculus acris* has not excited attention previously. None of the British floras consulted refer to it Since it came under my notice for the first time in 1923, I have seen it every subsequent season in fair abundance in my own neighbourhood. Apparently it is a general associate of the ordinary form of this buttercup. What exactly is its significance in the bionomics of the species it is difficult to say. One might hazard the view, tempting but not altogether probable, that *Ranunculus acris* is in the incipient stage from hermaphroditism to gynodiœcism.

Though no exact calculation as to the frequency of this 'female' form among the ordinary type in my neighbourhood has been made, one per cent might be a possible estimate, though of the extreme cases with stamens as mere rudiments this might be a considerable overstatement The extreme form is very noticeable on account of the much smaller size of the petals. Moving such 'female' plants to the garden has not changed the size or character of the flowers in subsequent seasons, so that the reduced nature of the corolla and the abortion of the stamens are apparently not due to poverty of soil or other adverse conditions. No difference in vegetative characters can be detected between the ordinary and the 'female' plants. The latter appear just as vigorous in growth.

JOHN PARKIN.
Blaithwaite, Wigton,
Cumberland, Mar. 20.

Excitation of Mercury Vapour by the Resonance Line.

IN supplement to my letter in NATURE of Mar. 30, p 488, under the above title, I have now made a series of experiments, starting with mercury resonance radiation under typical conditions at room temperature. As the temperature of the mercury is progressively raised, and a rapid stream of vapour is generated, the secondary source, originally symmetrical on either side of the primary beam, begins gradually to elongate on the down stream side, until finally it is wholly on this side, being traceable for a distance of about 3 cm. down stream.

Although this result is unexpected, and contrary to prevailing views, the photographic evidence is very clear. I hope to publish the photographs in due course. RAYLEIGH.

Terling Place, Chelmsford,
Essex, Mar 30.

Invisible Oxide Films on Metals.

THE well-known work of Evans on the passivity of metals has led to the conclusion that oxidation can occur at room temperature on copper and iron, giving a film which is too thin to show interference colours In his lecture to the American Institute of Mining and Metallurgical Engineers (1929) he has remarked that it is logical to suppose that the oxide film has a real existence before any interference tints are shown. Evans quotes the work of Freundlich, Patscheke, and Zocher (*Z. physikal. Chem* , **128**, 321; 1927), who have made pure metallic iron mirrors from iron carbonyl. They find distinct changes in the reflecting power when air is admitted, showing the formation of oxide films of the order of 10^{-7} cm in thickness.

Muller and Koenigsberger (*Phys Zeit.*, vol. 5, p 413; 1904) have found that there is little difference in the reflecting powers of iron in the active and passive states. In my experiments at temperatures at which the iron interference colours are formed very slowly, there is distinct evidence from the reflecting power of surfaces that there is an oxide film present before there is any evidence of interference colours visible to the eye (cf. *Proc. Roy. Soc.*, A, vol 117, p. 376; 1928)

In the early stages of oxidation the reflecting power of iron, nickel, and copper becomes somewhat smaller over the whole range of the spectrum, but slightly more so at the violet end of the spectrum than in the red, showing the existence of an absorption maximum far away in the ultra-violet region.

During the study of the spectrophotometry of the growth of sulphide films on metallic copper, evidence was obtained strongly supporting Evans's conclusions of the formation of an oxide film at room temperatures. If reduced copper be attacked with a mixture of one volume of hydrogen sulphide and five volumes of air, two complete colour sequences are produced in a few minutes; if, however, the copper surface be left exposed to air for some hours, and then hydrogen sulphide and air admitted, the interference colours are developed very slowly indeed. Only one colour sequence could be observed during a whole day's exposure. In addition there was a general dulling of the colours so formed.

Heating the metal to 300° C in a nitrogen vacuum of 10^{-3} mm. did not remove the film. Hence there is clear evidence in support of the conclusion that a thin film of oxide is formed on copper merely on exposure to air at ordinary temperatures.

F. HURN CONSTABLE.

St. John's College,
Cambridge.

Solutions and Heat Engines.

THE nature of osmotic pressure is a matter of such great importance both to chemists and to physiologists that I must again crave space to reply to the remarks of the reviewer in NATURE of Mar. 23, p. 445.

In justification of his, or van 't Hoff's, account of osmotic pressure, he points to the description in my book of what would happen if a mixture of two gases at atmospheric pressure in a rigid chamber was separated by a rigid septum, permeable by only one of the two gases, from pure gas of the same kind as could permeate, and at the initial pressure of the mixture. The pure gas would pass into the mixture, the pressure of which would rise until the pressure of the penetrating gas was the same in the mixture as outside of it. The gas which penetrates corresponds to the solvent in a solution, and the non-penetrating gas to the solute, while the extra pressure developed in the mixture might be held to correspond to osmotic pressure May I point out, however, that this extra pressure is due to solvent and not to solute molecules. There is thus in the phenomena no way of escape from the dilemma for van 't Hoff's theory which I indicated in my letter. Van 't Hoff's assumption that osmotic pressure is due to extra bombardment pressure of solute molecules is both unintelligible physically and inconsistent with the facts as revealed by the experiments of Morse and Lord Berkeley

The algebraical statement on page 25 of my book, to which the reviewer objects, is, I maintain, perfectly correct, and I am well content to leave the judgment as to its correctness with readers of the book.

J. S. HALDANE.

Cherwell, Oxford, Mar. 23.

I WILL add only one short note to what I have said. Consider two cases. (1) One atmosphere of hydrogen on each side of the septum and no nitrogen. The osmotic pressure is zero. (2) Two atmospheres of nitrogen inside the chamber and again one atmosphere of hydrogen on each side. This also is an equilibrium case and the osmotic pressure is TWO atmospheres. By what wild theory is this attributed to the ONE atmosphere of hydrogen! THE REVIEWER.

Science and Mathematics.

THE sentence italicised in the following from a work published in 1877, seems to have anticipated the views of relativists by half a century: "Any kabalist well acquainted with the Pythagorean system of numerals and geometry can demonstrate that the metaphysical views of Plato were based upon the strictest mathematical principles 'True mathematics,' says the *Magicon*, 'is something with which all higher sciences are connected, common mathematics is but a deceitful phantasmagoria whose much-praised infallibility only arises from this—that materials, conditions, and references are made its foundation.' . As long as exact science confines its observations to physical conditions and proceeds by the Aristotelian method it certainly cannot fail. But, *notwithstanding that the world of matter is boundless for us, it still is finite*, and thus materialism will turn forever in this vitiated circle, unable to soar higher than the circumference will permit. The cosmological theory of numerals which Pythagoras learned from the Egyptian hierophants is alone able to reconcile the two units, 'matter' and 'spirit,' and cause each to demonstrate the other mathematically."
—"Isis Unveiled," i. 7. W. W. L.

Evolution in its Course.

One of the most persistent plaints of the anti-evolutionist is that the biologist has failed to demonstrate to the satisfaction of the unbeliever the actual occurrence of evolution in the present-day world. The criticism is difficult to meet, for, apart from the blind eye which the critic is apt to turn to the well-meaning efforts of the biologist, evolution is a slow process not readily to be caught in its stride. Even amongst biologists themselves there has been a tendency in recent years to look askance at the work of the systematist, and to lean upon the experiments of the laboratory as the only sure test of biological processes

It is well to be reminded, therefore, that the last decade has seen a great advance in the technique of the systematist, and that the advance has afforded new ground for the examination of the problem of evolution in natural conditions. In the old days an account of the bird-life of a limited area in California would have meant little more than the bare records of a local list of the bird inhabitants, but, under the new analysis, Mr. Joseph Grinnell's "Distributional Summation of the Ornithology of Lower California" (*Univ. California Pub Zool.*, vol 32, No. 1, 1928, pp. 1-300) becomes a plea for the recognition of evolution in its course

Two factors have made for this progress in method. The first is the attention given to the discernment of minute differences in form, and it is sufficient answer to those who cavil at the difficulties of the determination of sub-species, that in these barely recognisable differences lie the critical, formative stages, which may lead to the development of easily distinguished species The second factor lies in the attempt to associate these minute differences of sub-species with the peculiar conditions of environment in which each is situated, in an endeavour to discover something of the causes and essential conditions of the differentiation.

The general results of the analysis of the bird-life of California show, then, the progress of evolution in Nature, as closely as the examination of static conditions can be expected to interpret a continuous process They do not reveal anything that is particularly novel or unexpected, but the fact that they are based upon an intensity of examination and detail of comparison such as was unavailable to Darwin or Wallace, lends them new weight and authority.

In the first place, there is evidence of gradual differentiation. Among the numerous races of Californian birds, examples can be selected showing practically every appreciable stage in differentiation, from neighbouring stocks showing departures from a type so slight that they can be appreciated only when a long series of individuals is averaged, to full-blooded species, sharply distinct, no longer crossing with related species, judging from the absence of wild hybrids

In the second place, the differentiation, that is, the variational move towards species, is not everywhere a uniform process. The inequality may be associated with several definite characters of the environment Thus, in many of the groups of wide distribution, the amount of difference shown by the geographical races varies directly with the degree of spatial separation. Take the clear case of the group including the California linnet (*Carpodacus*) The group extends over the mainland, a distance north and south of some eight hundred miles, and in that space has three recognisable subspecies But on Los Coronados Islands, only seven miles off shore, there is another race, appreciably but not constantly or conspicuously different Forty miles from the nearest mainland, on the San Benito Islands, there are greater and fairly constant differences from the birds of the mainland, and on Guadalupe Island, 135 miles away, the differences are so great and constant that the form there is designated a full species

The differences themselves are significant The Guadalupe birds are distinguished by their larger size, longer legs, relatively shorter wings, and shorter keel of sternum—indications of a loss of wing power, which suggest a step towards the flightlessness of some other birds on remote Pacific islands

Even a slight water barrier may be influential as an effective form of isolation, preventing free interbreeding of birds from neighbouring places. Although there are no apparent barriers in the whole extent of the mainland of lower California, long distance has had the same isolating effect, allowing differentiation in remote stocks despite commingling over adjacent territory

Other cases of the influence of isolation, such as that shown by the spotted towhee (*Pipilo maculatus*), could be cited; they illustrate the fact that closely similar races in a series are not situated "within the same differentiation area, nor yet in remote differentiation areas, but in separate and adjacent differentiation areas"

In the third place, it becomes clear that environment may have an effect which, no matter that the subjects of its influence are different, results in a remarkably similar set of results. A very peculiar climatic condition exists between the crest of the Sierra San Pedro Mártir and the Pacific, where a region of meagre rainfall has a high atmospheric humidity—a humid desert. Various birds in this region, as different as flycatchers, finches, and woodpeckers, show similar modifications, especially marked in deeper coloration, certain proportions of wing and tail, lesser size of bill, and so on. Subjection of very different stocks to the same peculiar set of critically important conditions has brought parallel modifications in certain functions and structures.

This suggests that the inherited variations have not been random, but have been directed So far so good, but the author goes on to say that sub-specific characters are therefore to be regarded, either intrinsically in themselves or in their linkages, as of *worthy* sorts in the racial struggle for existence —not, ordinarily, indifferent or useless ones. Here he seems to travel in advance of his facts, for it has

yet to be shown that the common characters which have been induced by a peculiar environment in so many different kinds of birds can have an equal survival value to each of these birds of habits so different On the facts put thus, the safer assumption would seem to be that similar conditions induce a similar organic reaction irrespective of 'worthiness' or 'unworthiness.'

After all, unworthiness in the evolutionary sense is not likely to survive in hard competition with worthiness, and Mr Grinnell finally reaches a Darwinian conclusion "The accumulating evidence of the field naturalist is bringing conviction that the incipient species in nature, the subspecies, owes its origin to a process, on a vast scale, of trial, discard, and preservation, of individuals, and of groups of individuals comprising populations, which populations from generation to generation are thereby rendered more nearly adjusted to such environments as they can endure at all But environments themselves never stabilize; they are changing, proliferating, evolving continually. A balanced state of perfect adaptation of the organism can never be attained, but only continually approached, such approach being forced, under penalty of extinction" J. R.

Physical Foundations of Chemical Theory.

No task is more difficult for the chemist of the present day than that of trying to keep abreast with those advances in atomic physics which affect him so closely that he cannot ignore (even if he cannot hope fully to understand) them Sidgwick's book on "The Electronic Theory of Valency," which was reviewed at length in these columns last year (April 7, 1928, vol 121, p 527), provided a partial solution of the problem from the chemist's point of view, but the brief monograph of Lessheim and Samuel referred to below [1] may be regarded as a complementary contribution of unrivalled value from the physical side The professional spectroscopist does not often realise how difficult his subject can be made for the lay reader, and it is a common experience, even when reading books or lectures of a semi-popular character, to be pulled up short by technical or controversial details of which no explanation is given or attempted.

In the more leisurely days of the past, there was usually ample time for one fundamental idea to be grasped before attention was distracted by the next new development. Progress was then made by the orderly passing of the ball from one three-quarter back to another, until it was safely placed behind the goal, and in due course 'converted' from speculation or hypothesis to theory Now, however, the ball progresses amid the confusion of a wild 'forward' rush, in which the casual onlooker can only occasionally get a glimpse of the ball, and has but little chance to observe the effects of individual play, whilst even the professional reporter is in danger of overlooking essential points in the game. Thus, whereas Bohr's 'principal quantum number' n had a sufficient start to secure universal acceptance, and has retained its strictly integral character, it has been followed in the works of subsequent authors by a trail of subsidiary numbers, which are in open competition with one another, and (to add to the confusion) appear at some stage to have undergone a process of 'disintegration' whereby integral quanta have been resolved into proper fractions

The difficulties arising from such causes as these are in large measure removed by the careful and concise exposition of Messrs. Lessheim and Samuel, and it is a high compliment to their skill that we can claim to have been able to understand and to make use of the major portion of their monograph It was, indeed, only on reaching the tenth section of the book that it became necessary to add a marginal comment, "I cannot follow this," and to call in the help of a professional physicist to explain in fuller detail the complex behaviour of systems with several outer electrons. The elaborate spectroscopic analysis of sections 12 and 13 was also too complicated to be understood at one reading, but it would be difficult to praise too highly the way in which the spectroscopic evidence is used in order to provide a sure foundation for definite chemical deductions, and it is one of the conspicuous merits of the book that this evidence is set out in such a convincing way, that its validity is no longer open to question even by the most extreme type of 'sceptical Chymist.'

Much of the charm of the quantum theory of the present day arises from the introduction, by Goudsmit and Uhlenbeck in 1925, of the conception of the spinning electron This conception has, indeed, done more than anything else to bring order out of the chaos of subsidiary quantum numbers, and thus to restore to Bohr's theory some semblance of the simple and logical character which it possessed in 1913. From the chemical point of view, the principal merits of this early quantum theory was the provision of a logical basis for the valency theories of Kossel and Lewis, since it indicated the existence of groups of electrons with identical 'principal quantum numbers' $n=1, 2, 3, 4, 5$, etc, corresponding with the K, L, M, N, O, etc., levels of the X-ray spectra of the elements. In this way it explained the inertness of the noble gases, and the ionisation of adjacent elements such as the halogens and the alkali metals, as depending on the exceptional stability of certain completed groups of electrons. Since, however, the theory gave no clue to the number of electrons in each quantum group, these numbers must logically have followed the Rydberg series, with 2, 8, 8, 18, 18, and 32 electrons in successive levels, corresponding with the number of 'cells' which Langmuir postulated in successive layers or 'shells' of his static atomic model.

[1] Die Valenzzahl und ihre Beziehungen zum Bau der Atome Von Hans Lessheim und Rudolf Samuel (Fortschritte der Chemie, Physik und physikalische Chemie, herausgegeben von A Eucken, Band 19, Heft 3) Pp. 98 (Berlin Gebruder Borntraeger, 1927) 6 40 gold marks

Two years later, in 1915, Sommerfeld found it necessary to introduce a second (' subsidiary ' or ' azimuthal ') quantum number k, in order to explain the fine structure of the hydrogen and helium spectra. This ' subsidiary ' quantum number immediately assumed a dominant position in spectroscopy, where series of spectroscopic terms for which $k=1, 2, 3, 4,$ were distinguished by the capital letters S, P, D, F, corresponding with the initial letters of the ' sharp,' ' principal,' ' diffuse,' and ' fundamental ' series of spectral lines with which the terms are associated. It is unfortunate for the lay reader of spectroscopic literature that the fascinating explanation which Sommerfeld gave of the fine structure of hydrogen, as depending on the varying mass of electrons moving with varying velocity in elliptical orbits of different eccentricities, has now been abandoned in favour of a fine structure depending on a third (instead of on the second) quantum number, but the classification of Bohr's ' groups ' of electrons into ' sub-groups,' under the headings $n_k = 1_1 2_1 2_2 3_1 3_2 3_3$, etc., was nevertheless an advance of permanent value. In particular, it was these sub-groups which enabled Bohr in 1921 to develop his well-known classification of the elements, in which the inertness of the noble gases is no longer attributed to the completion of the main groups with principal quantum number $n=1, 2, 3, 4$, etc., but to the completion only of successive n_1 and n_2 sub-groups, as in the table below.

X-ray level	K.	L	M	N	O	P.
Quantum No.	1_1	$\underbrace{2_1 2_2}$	$\underbrace{3_1 3_2} 3_3$	$\underbrace{4_1 4_2} 4_3 4_4$	$5_1 5_2 5_3$	$6_1 6_2$
He = 2 =	2					
Ne = 10 =	2	+ 8				
A = 18 =	2	+ 8	+ 8			
Kr = 36 =	2	+ 8	+ 18	+ 8		
X = 54 =	2	+ 8	+ 18	+ 18	8	
Rn = 86 =	2	+ 8	+ 18	+ 32	18	

This well-known system of classification assigns an outer shell of 8 electrons to each of the noble gases, and explains the old ' law of octaves ' by the repetition which results from building up this outer octet in one level after another. It then proceeds to account for the properties of the transition elements of the first and second long periods as depending on a subsequent expansion of the M and N octets into shells of 18 electrons. The final expansion of the N octet to a shell of 32 electrons (at a stage when the O and P levels are already partially filled) then provides a natural explanation of the still slower gradation of properties in the elements of the rare earth group.

Since the number of similarly placed electrons was still undetermined, Bohr adopted the simple plan of distributing them equally amongst the sub-groups of a given level. The N-level was therefore supposed to contain $4+4$ electrons in krypton, $6+6+6$ in xenon, and $8+8+8+8$ in radon. It is, however, rather illogical to postulate that a condition of maximum stability exists in a sub-group when occupied by 4 *or* 6 *or* 8 electrons. Stoner therefore suggested in 1924 that the various sub-groups should be filled up completely one after another, and then remain full to the end of the chapter. It then follows logically that the sub-groups for which $k=1, 2, 3, 4$, etc., must contain 2, 6, 10, 14, etc., or in general $2(2k-1)$ electrons, whatever may be the value of the principal quantum number n. The close similarity between the members of the various natural families of elements was then explained by the identical development of successive sub-groups differing only in their ' principal ' quantum numbers. Thus the alkalis all contain *one* electron in an n_1 sub-group, whilst the alkaline earths contain a complete sub-group of *two* electrons. In the same way carbon and its homologues contain *two* electrons in an n_2 sub-group, in addition to the two electrons in the n_1 sub-group, whilst the inert gases contain a complete sub-group of *six* n_2 electrons.

In the periodic classifications of Bohr and of Stoner, the maximum number of sub-groups in a group is fixed by the fact that k may have any integral value between 1 and n. The number of sub-groups is therefore equal to the principal quantum number n, and has the value 1, 2, 3, 4, 5, in the K, L, M, N, O levels. Coster found, however, in 1921, that the X-ray absorption spectra of the elements have a fine structure like that of hydrogen or helium, the number of components in the K, L, M, N, O, P levels being expressed by the series 1, 3, 5, 7, (5), (3), instead of the series 1, 2, 3, 4, 5, 6. In order to explain this result, he introduced a third quantum number in the form $n_{k_1 k_2}$, where k is now written as k_1 and may be any integer between 1 and n as before, whilst k_2 may be either equal to k_1 or 1 unit less. The sub-groups of the preceding classification are thus divided up into ' grouplets ' corresponding with a series of triple quantum numbers as follows: 1_{11}, 2_{11}, 2_{21}, 2_{22}, 3_{11}, 3_{21}, 3_{22}, 3_{32}, 3_{33}, etc. This system gives the required series of 1, 3, 5, 7 components in the K, L, M, N levels, as required by the X-ray spectra, and we may then suppose that, as in the optical spectra, the O and P levels are only partially filled.

A third quantum number had already been introduced by Sommerfeld in 1920 in order to account for the composite character or ' multiplicity ' of lines, such as the sodium doublet, which could not be explained by means of the first two quantum numbers. Sommerfeld's ' inner ' quantum number j can have integral values when there are *two* valency electrons which can move from orbit to orbit during the absorption or emission of light by the atom, as in the alkaline earths, but when there is only *one* of these electrons it becomes a half-integer, and its value is given by the relation $j=k_2-\frac{1}{2}$. This third quantum number is evidently magnetic in origin, since it also explains the multiplicity which is developed when spectral lines are emitted in a strong magnetic field as observed by Zeeman in 1896. Under these conditions a single line is resolved into $2j+1$ components, where j is the inner quantum number.

Thus if j is an integer, the lines break up into an odd number of components, but into an even number if j has a half-integral value

The significance of the third quantum number becomes clear only when a quantised spin is given to the electron The magnetic moment s of the spinning electron can then be either positive or negative; but, since there is no intermediate resting state, only a single quantum separates the two states For the sake of symmetry, therefore, these states are written $s=\pm\frac{1}{2}$ for each electron, and we have at once a plausible explanation of those half-quantum numbers which have so often caused the sceptical to scoff. The total magnetic moment j of a planetary electron is then made up of two parts, the magnetic moment of the orbit l and of the spin s, so that $j=l\pm s$, since the moments may either work together or oppose one another. The magnetic moment l of the orbit is a function of the second or 'subsidiary' quantum number k, and is given by the simple relation $l=k-1$ Thus if $k=1$ (as in the S terms of a spectroscopic series) $l=0$, and since $j=l+s$ cannot be negative, the only possible value of the 'inner' quantum number when $s=\pm\frac{1}{2}$ is $j=\frac{1}{2}$ If, however, $k=2$ (as in the P terms of a spectroscopic series), then $l=1$, and $j=l+s$ can have the *two* valves $j=\frac{1}{2}$ or $j=\frac{3}{2}$ An electron-fall from a 2_2 to a 1_1 orbit can thus give rise to the yellow doublet of sodium, since the falling electron may be spinning either in the same sense as its revolution in the orbit or in the opposite sense.

The introduction of the second quantum number had the effect of breaking up the main groups of 2, 8, 18, 32 electrons into sub-groups of 2, 2+6, 2+6+10, and 2+6+10+14 electrons The third quantum number has the effect of breaking up these sub-groups into tiny grouplets containing small even numbers of electrons Thus Bohr's big group of 32 N electrons is resolved into the following grouplets:

$$\begin{array}{ccccccc} 4_{11} & 4_{21} & 4_{22} & 4_{32} & 4_{33} & 4_{43} & 4_{44} \\ 2 & 2 & 4 & 4 & 6 & 6 & 8, \end{array}$$

and the 54 electrons of xenon are now distributed amongst 17 grouplets as follows 2, 2+2+4, 2+2+4+4+6, 2+2+4+4+6, 2+2+4 This has the effect of emphasising more strongly than ever the significance of the duplet or pair of electrons, since each completed grouplet is magnetically inert, but the octet is relegated to a subsidiary position as a mere summation of the first three grouplets in a group which contains $2n-1$ of these tiny clusters

In order to complete this process of resolution, we must now proceed to consider the fourth quantum number m, which represents the various settings of the atom in an external magnetic field. This fourth quantum number changes by one unit at a time from $+j$ to $-j$, and may therefore be either integral or half-integral The number of settings for a given value of j is given by the formula $2j+1$, thus if $j=\frac{1}{2}$, $m=\pm\frac{1}{2}$ and has *two* values, if $j=1$, $m=-1$, 0, $+1$ and has *three* values; whilst if $j=\frac{3}{2}$, $m=-\frac{3}{2}$, $-\frac{1}{2}$, $+\frac{1}{2}$, $+\frac{3}{2}$ and has *four* values The total number of settings of the *four* quantum numbers n, l, j, and m is then found to agree exactly with the maximum number of electrons that can be collected in groups, sub-groups, and grouplets round the nucleus We are therefore at last in a position to appreciate Pauli's 'exclusion rule,' according to which no two electrons in an atom can have the same four quantum numbers, n, l, j, and m. A sample of the table which expresses this rule is reproduced below.

				Number of Settings			
$n=1,2,3,4,5,6.$	$l=0$	$j=\frac{1}{2}$	$m=-\frac{1}{2}+\frac{1}{2}$	2	2	8	18
$n=\ \ 2,3,4,5,6$	$l=1$	$j=\frac{1}{2}$	$m=-\frac{1}{2}+\frac{1}{2}$	2	6		
		$j=\frac{3}{2}$	$m=-\frac{3}{2}+\frac{1}{2}+\frac{1}{2}+\frac{3}{2}$	4			
$n=\ \ 3,4,5,6$	$l=2$	$j=\frac{3}{2}$	$m=-\frac{3}{2}-\frac{1}{2}+\frac{1}{2}+\frac{3}{2}$	4	10		32
		$j=\frac{5}{2}$	$m=-\frac{5}{2}-\frac{3}{2}-\frac{1}{2}+\frac{1}{2}+\frac{3}{2}+\frac{5}{2}$	6			
$n=\ \ 4,5,6$	$l=3$	$j=\frac{5}{2}$	$m=-\frac{5}{2}-\frac{3}{2}-\frac{1}{2}+\frac{1}{2}+\frac{3}{2}+\frac{5}{2}$	6	14		
		$j=\frac{7}{2}$	$m=-\frac{7}{2}-\frac{5}{2}-\frac{3}{2}-\frac{1}{2}+\frac{1}{2}+\frac{3}{2}+\frac{5}{2}+\frac{7}{2}$	8			

This table gives a picture of the periodic classification from which all individuality is excluded, since exactly the same sequence recurs when $n=2$, 3, 4, etc It thus represents one of the main characteristics of the elements perfectly, namely, the recurrence of types such as the halogens, noble gases, and alkalis at appropriate intervals, but in practice the elements of a given family are far from uniform in their behaviour, so that even the formal valencies vary erratically in a family such as copper, silver, gold It is therefore satisfactory to find that the spectroscopic evidence, when examined in detail, gives similar indications of more complex developments Thus it is found experimentally that, in the elements of the *first* transition series, the grouplet 4_{11} of the N level is occupied by *two* electrons (except in chromium and copper) so that all these elements readily form bivalent ions In the same way, the first two elements (yttrium, zirconium) of the *second* transition series have *two* electrons in the 5_{11} grouplet of the O level; but at this stage there is an abrupt change, since the following elements (niobium, *et seq*) have only *one* electron in the 5_{11} grouplet, and palladium actually has *none* In the next group of transition elements tungsten appears to have *two* electrons in the 6_{11} grouplet, but no conclusion can be drawn in reference to the other elements of this transition series, since the relevant spectroscopic data are not yet available These unforeseen 'anomalies' are of peculiar interest, since they show that the individuality of the elements, which makes inorganic chemistry appear so much less systematic than organic chemistry, is manifested also in their spectroscopic behaviour, which may therefore be expected to provide a clue to the common origin of these physical and chemical anomalies in the electronic configuration of the atom.

A particularly interesting comparison can be made between nickel, palladium, and platinum. The structure of these three elements could be represented most easily by assigning an outer

shell of 18 electrons to each metal, as in the scheme:

$$\begin{array}{lllll} & K & L & M & N \quad O \\ Ni = & 2 + & 8 + & 18 & \quad = 28 \\ Pd = & 2 + & 8 + & 18 + & 18 \quad = 46 \\ Pt = & 2 + & 8 + & 18 + & 32 + 18 = 78 \end{array}$$

This structure is correct in the case of palladium, which appears to contain a series of complete grouplets, since it is only feebly paramagnetic and gives a spectrum with some of the characteristics of a noble gas, but it is no longer true for nickel and platinum, the spectra of which are more like those of the alkaline earths, so that their structure may be represented more efficiently by the schemes $2+8+16+2$ and $2+8+18+32+16+2$

The spectroscopic data thus explain the typical bivalency of nickel and its resemblance to the bivalent transition elements with which it is associated, but they do not throw much light on the chemistry of palladium and platinum, since these two metals do not show any analogous contrast in their chemical behaviour If, however, we consider the coinage metals of the succeeding family, Cu = 29, Ag = 47, Au = 79, the value of the spectroscopic data is at once seen Thus, since palladium contains only completed groups or sub-groups of electrons, and has therefore a very stable electronic configuration, it is natural that silver should exhibit the simple spectrum and rigid univalency of an alkali metal, as expressed in the scheme $Ag = 2+8+18+18+1$ In the case of copper, the univalency of the element in its cuprous salts is similarly expressed in the scheme $Cu = 2+8+18+1$. In strict conformity with this scheme, the cuprous ion, $Cu^+ = 2+8+18$, which has three levels completely filled, is diamagnetic; but the cupric ion, which possesses an incomplete shell $Cu^{++} = 2+8+17$ is paramagnetic. Since copper is usually bivalent, we might expect to find spectroscopic evidence of a configuration $Cu = 2+8+17+2$, corresponding with $Ni = 2+8+16+2$, with two electrons in the 4_{11} grouplet, but this does not appear to have been observed On the contrary, the presence of quadruplet groups in the spectrum of copper indicates the presence of *three* unpaired electrons round the central nucleus This brings the metal into line with nickel, but in a different way, since the stable core of electrons has $2+8+16$ electrons in each case, but it is not in accord with the chemical properties of the element, which may be univalent but is never tervalent.

The univalency of gold finds expression in the configurations

$$Au = 2+8+18+32+18+1,$$
$$Au^+ = 2+8+18+32+18,$$

which show the presence of *one* easily detached electron in the P level Its tervalency can be deduced from the analogy between the spectra of platinum and those of the alkaline earths with *two* easily detached electrons, since this indicates the existence of a stable core with 16 O-electrons as in the scheme

$$Au^{+++} = 2+8+18+32+16,$$
$$\text{compare } Pt = 2+8+18+32+16+2$$

In this connexion, the univalency of thallium, which finds expression in the scheme $Tl^+ = 2+8+18+32+18+2$, is of interest, since it provides further evidence of the stability of the outer sub-group of two 6_1 electrons which has already been deduced from the spectroscopic data for platinum

The introduction of sub-groups of elements has the interesting effect of removing carbon and silicon from the central position which they have long occupied in the minds of chemists as the middle

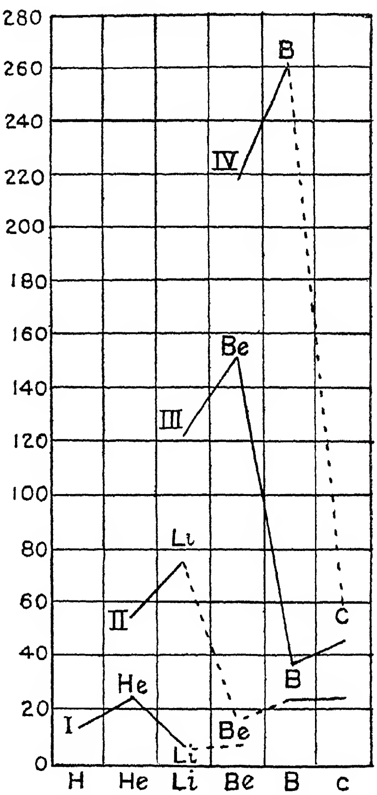

FIG 1—Diagram showing the ionisation potentials required to remove 1, 2, 3, or 4 electrons from the first six elements

members of the two short periods of elements From the spectroscopist's point of view, however, a sub-group 2_1 or 3_1 has been completed at beryllium and magnesium, and it only remains to build up the six electrons of the 2_2 or 3_2 sub-groups in order to give the configuration of a noble gas In this process, nitrogen and phosphorus usurp the median positions, and this is revealed by an unexpected symmetry in the spectroscopic terms of the elements on either side. Thus the spectrum of magnesium shows some resemblance to that of argon, whilst aluminium and chlorine, and silicon and sulphur form similar pairs, in which the electrons which are present in one element are represented by gaps in the other. A similar symmetry is seen on either side of manganese in the transition elements of the first long period,

where the 3_3 sub-group is being filled up, but in this case the symmetry is marred by the fact that chromium and copper have only *one* outer electron instead of two in the 4_{11} grouplet. In the elements of the rare earths, where the 4_4 sub-group is being filled with fourteen electrons, gadolinium occupies a central position in a series of fifteen elements ranging from lanthanum to cassiopeium; but in this case the central element is characterised by an extraordinary maximum of multiplicity, $r=17$, which is far in excess of the previous maximum values, namely, $r=4$ for nitrogen and phosphorus, and $r=6$ for manganese, or $r=7$ for the anomalous spectrum of chromium

The culminating feature of Messrs. Lessheim and Samuel's monograph, in our experience, is found in a diagram of ionisation potentials (Fig 1), which provides the most convincing proof of the real existence of electron-groups The minima at Li^+, Be^{++}, B^{+++}, and C^{++++} show how easy it is to remove the whole of the electrons from the L level in lithium, beryllium, boron, and carbon, but, on attempting to remove one more electron, an immense resistance is at once encountered to the disintegration of the still complete K-shell, and the ionisation potential leaps up to a maximum. When once this shell is broken, however, only a feeble resistance is offered to its complete removal. Thus the two L electrons can be removed from an atom of beryllium by two increments of about 8 and 7 volts, but the removal of the two K electrons requires the successive addition of 138 and 46 volts to the previous total of about 15 volts. The most striking feature of these numbers is the drop of nearly 100 volts in the extra work that is required to strip the nucleus bare by the removal of one more electron when once the K-shell has been broken Even the tiny duplet of the 2_{11} grouplet appears, however, to put up an appreciable resistance to disruption, since rather less extra work is required to remove an electron from the ion Be^+ than from the neutral atom Be. Facts such as these provide ideal evidence in support of the main thesis of the electronic theory of valency, that chemical affinity in all its various manifestations depends on the superior stability of certain numerical groups of electrons when under the influence of a positively charged nucleus. In our opinion, this thesis now rests on an impregnable rock of experimental proof T M LOWRY.

Christian Huygens, 1629–95.

OF all men of science whose lives were passed within the compass of the seventeenth century, none has a more lasting reputation than the Dutch mathematician, natural philosopher, and inventor, Christian Huygens Born on April 14, 1629, three hundred years ago, at a time when the work of Kepler, Galileo, Napier, Gilbert, and Harvey was slowly gaining acceptance, he lived to read Newton's "Principia," and during the course of his career saw the rise of experimental science, the erection of famous observatories, and the foundation of our greatest scientific societies, the Royal Society and the Paris Academy of Sciences, of the latter of which he was the first foreign associate

Huygens' birth, and his death on June 8, 1695, both took place at the Hague, and his tomb, like that of his illustrious countryman, Boerhaave, is there in St Peter's Church With advantages of birth, education, wealth, and position, Huygens possessed a studious and industrious mind, and an even and cheerful temper, and by the exercise of his brilliant intellect he raised himself to pre-eminence among his contemporaries Trained in the law and for a short time attached to a Dutch embassy, he was all his life free to follow his own bent, and his long sojourn in Paris, where he enjoyed the seclusion of the Bibliothèque Roi, and his visits to England, no less than his investigations, discoveries. and inventions, led to his being esteemed by a wide circle of friends

The life and works of Huygens have been published and republished, but reference can be made to only one or two of his great contributions to the advancement of knowledge Attracted in his youth, like many of his fellows, to the construction and improvement of telescopes, on Mar. 25, 1655, Huygens discovered Titan, the sixth, but the first seen, of the satellites of Saturn, and then gave the true explanation of the curious appearance of the 'triple planet' This discovery of Saturn's ring he made known in the form of a logogriph, which is reproduced by Grant in his "History of Physical Astronomy." In after years Huygens presented to the Royal Society an object glass of 122 feet focal length for an 'aerial telescope,' for the mounting of which Halley was commissioned by the Society to "view the scaffolding of St Paul's Church" to see if it could be used for erecting the object glass

From astronomy and telescopes Huygens turned to clocks, and on June 16, 1657, presented the first pendulum clock to the States General. Described later in his famous work "Horologium Oscillatorium," of 1673, a replica of the clock is to be seen in the Science Museum. Of that famous work, it has been said that it contained original discoveries sufficient to have furnished material for half a dozen striking disquisitions, while "the theorems on the composition of forces in circular motion with which it concluded formed the true prelude to Newton's 'Principia' and would alone suffice to establish the claim of Huygens to the highest rank among mechnaical inventors." This work, like his "Traité de la Lumière," in which he enunciated the undulatory theory of light, was written while he lived in Paris

Returning to his native country in 1681, Huygens continued his writings, and his last work, "Cosmotheoros," was in the printers' hands when he was attacked by the illness which proved fatal It is said that Flamstead recommended the "Cosmotheoros" to Dr. Plume, archdeacon of Rochester, who was so struck with it that he left £1800 to found the well-known Plumian professorship of astronomy at Cambridge.

Obituary.

DR ALEX HILL

DR ALEX HILL, whose death was recently recorded in NATURE, was born at Loughton, Essex, and educated at University College School and at Downing College, Cambridge, in 1880 he was elected a fellow of the College, from 1888 to 1907 he was Master of Downing, and from 1897 to 1899 Vice-Chancellor of the University He studied medicine and surgery at St Bartholomew's Hospital, in 1884–85 he was Hunterian professor of the Royal College of Surgeons

The greater part of Dr Hill's life was spent in the advancement of learning; his services, not being confined to the routine of academic life, were given widely to educational causes He assisted in the formation of the National Home Reading Union, of which he was the chairman from 1888 to 1908 He served as president of the Teachers' Guild of Great Britain, and was a member of various educational committees, including the Welsh Colleges Committee, 1907–8, and the Advisory Committee of the Treasury on Universities, 1901–6

A versatile and an attractive writer, Dr Hill was the author of several books and papers on physiology and on other subjects connected with the profession for which he had been trained. His geniality, personal charm, and eloquence attracted crowded audiences in various parts of the country, when as a Gilchrist Lecturer he dealt with physiological and psychological subjects such as "Man under the Microscope" and "Dual Personality." His literary gifts were evident in his series of lectures on Browning and in his interpretation of the poet in his "Notes on Browning."

Dr. Hill was zealous in his advocacy of university education, and having formed the conception of university institutions as centres of educational influence in areas not already served by universities, he strove to put his ideals into practice With this aim in view he accepted an urgent appeal to become the Principal of University College, Southampton, a position which he took up in January 1913 His task was not an easy one, but he entered on it with characteristic enthusiasm; his winsome personality had an immediate effect on all branches of the College activities, and he was able to secure support for the new College buildings which had been planned for the present site at Highfield The outbreak of the War so soon after he had entered upon his duties was a serious blow to the growing College, a large number of the staff and students joined the forces, and the new buildings were occupied as a war hospital Dr Hill's own residence at Highfield Hall, which he had taken as a centre for the social activities of the College, he gave up to the Red Cross Society, and lived in a house near it in order to be able to assist the work of the hospital Always a hard worker, his energy during the War was boundless, for in addition to carrying on his duties as Principal of the College, he took on himself the work of the Universities Bureau when his assistant secretary joined the forces. His recreation was in the garden attached to Highfield Hall, and even at this strenuous period of his life he rose early each morning to work in the garden, where he grew vegetables and flowers for the wounded soldiers in the hospital

The work with which Dr Hill especially identified himself since 1912 was that of secretary of the Universities Bureau of the British Empire The Bureau owes its inception to Dr Hill, who, when he resigned his position as Principal of the University College, Southampton, told the writer that there were two claims both very dear to him, those of the College and the Bureau; but whilst he felt that others could carry on the work of the College, the Bureau was his own child, and his one aim in life was to nurse it and to bring it to maturity

A man of broad sympathies and wide vision, Dr Hill endeared himself to those who knew him His tour with his family, so well described in his book "Round the British Empire," strengthened his vision and he felt more intensely that the work which he was undertaking was a means of cementing more firmly the bonds of Empire Since 1920, although his work was mainly in London, his home was in Southampton, and his connexion with the College maintained by his election as a vice-president He died at 'Granta,' Upper Bassett, Southampton, on Feb 27, and leaves a widow, a son, and a daughter J EUSTICE

WE regret to announce the following deaths.

M. J. Boussinesq, member of the Section of Mechanics of the Paris Academy of Sciences and author of a mathematical work on the theory of light, on Feb. 19, aged eighty-six years.

Sir Anthony Bowlby, Bart., K C B, K.C.M G., K.C.V.O., a past president of the Royal College of Surgeons of England, on April 7, aged seventy-three years.

Dr Jonathan Dwight, president in 1923–26 of the American Ornithological Union, on Feb 22, aged seventy years

Dr. H B Gray, formerly warden of Bradfield College, and president in 1909 of Section L (Educational Science) of the British Association, on April 5, aged seventy-seven years.

Sir George Knibbs, C.M.G., Commonwealth statistician from 1906 until 1921, and president in 1923–24 of the Australasian Association for the Advancement of Science, aged seventy years.

Dr. Thomas B. Osborne, since 1886 research chemist in the Connecticut Experiment Station, who was an honorary fellow of the Chemical Society of London, and was distinguished for his work on the chemistry of the vegetable proteins and related subjects, on Jan. 29, aged sixty-nine years.

Sir Henry Rew, K.C.B, sometime Assistant Secretary, Ministry of Agriculture, and a past president of the Royal Statistical Society and of Section M (Agriculture) of the British Association, on April 7, aged seventy years

Dr Thomas Scott, associated for many years with the Scottish Fishery Board Laboratory and known for his work on the smaller marine crustacea, especially copepoda, in recognition of which the University of St. Andrews conferred on him the honorary degree of LL D, on Feb. 25, aged eighty-eight years.

News and Views.

There are two thinkers in England just now working on very similar lines, investigating the relations of science and art. Both are 'emeritus' professors, Lloyd Morgan of Bristol, Alexander of Manchester, and every reader of any of their publications on the subject must be struck by the earnestness and penetration of their work and the palpable and complete sincerity of their minds. It is much to be hoped that they will persevere and that Prof. Alexander, who has already several lectures and pamphlets on the subject to his credit, will soon be able to bring out the systematic volume which he has in mind. Prof. Lloyd Morgan gave two lectures at Bristol last November entitled "Science and Drama" (University of Bristol), which really deal with the same topic He uses the term 'drama' in the widest possible sense in order to cover all forms of 'agency,' and while in the first he considers the question of 'agency' in respect of natural phenomena which are studied in science, in the second he examines in detail what Alexander has already said about the action of the mind in art, on the whole accepting it and adding certain 'glosses' of his own.

Prof. Lloyd Morgan's second lecture sums up and gives the author's own point of view in his now familiar phrase of 'emergence.' Science and art, he tells us, both give entry to a realm which is transformed in contrast with the world of naive perception. The square box, for example, which we see as we move about in a room is transformed by the most elementary operation of science into a cube We never see it as a cube but we think so consistently in a transformed mental attitude that we always say that what we see is really a cube The difference in this respect between the man of science and the artist is that for the latter it is always the appearance which in his sense is the real There is, however, in both cases the scientific and the artistic result, something added by the thinker or the artist. In the latter case the artist transforms the real as he perceives it into something having an 'art-value,' and it is in this process of transformation, whether of the artist himself or of those who follow him in appreciating his work, that Prof. Lloyd Morgan finds the new or 'emergent' attitude of mind which is the keystone of his philosophy. It is the turning-point in mental development, and probably not attained by the animal or the little child. Then comes a careful and stimulating analysis of Alexander's account of the same process The two philosophers by no means agree on all the points which arise, and it is this comparison of results which makes the discussion so interesting. English writers have not hitherto equalled the best of the German, Italian, or French philosophers who have studied æsthetic, and it is therefore the more gratifying to find a pair of subtle and mature minds engaged in friendly competition to fathom the depths of one of the most fundamental problems of thought Both, it should be noted, agree in placing the decisive element in the thinking mind.

In a recent leading article in Nature (Feb. 16, p. 233) the connexion between forests and agriculture as considered in the Report of the Royal Commission on Agriculture in India was considered In different parts of India, a study of the history of the past sixty years or so has resulted in the steady growth of an opinion which recognises that there is a definite relation between unchecked abuses in the forest (by axe, fire, and overgrazing) and subsequent forest degradation, erosion, drying up of the waters and covering up of valuable agricultural lands Those who have studied these problems in India will not, perhaps, be aware how widespread and important they have become in other parts of the world. Recently (Feb. 27–Mar. 1) a three days' joint session of the American Forestry Association and the Florida Forestry Association was held at Jacksonville, Fla, to discuss the position of the southern forests and their industrial, conservational and recreational significance to the United States. The main object of the meeting, according to a *Daily Service News Bulletin* issued by Science Service, Washington, D C, was a consideration of the steps to be taken "to reclaim for full production the vast tracts of southern land that are better adapted for forest crops than for any other purpose." One of the sessions was devoted to a consideration of the fire evil. "Forest fires in the south," it is said, "are different from those in other parts of the country in that most of them are deliberately started by cattle owners under the mistaken impression that burning improves pasture How to persuade these people that they are burning money out of their own pockets is one of the most pressing problems confronting southern forestry men." Forestry men in India have been engaged upon this problem for sixty years and more, and Florida foresters could doubtless study the work of the past in India with profit.

Mr E. A. Sherman, of the United States Forest Service, in dealing with the important problem of soil exhaustion and erosion as a result of the destruction of the forests, said "Our fields have been robbed of their fertility almost beyond human comprehension. Millions of acres have, through our ignorance, been rendered relatively worthless . . . The far-sighted thrift upon which was founded that part of the common law which places a taboo upon waste is still sufficiently inherent in our people to assure us that it will be applied as soon as the man in the street realises the presence of that waste and its extent. He will insist upon prohibiting forms of agriculture that result in a permanent shrinkage in our total agricultural domain. Economic pressure and the pressure of public opinion will combine to exclude certain classes of land from cultivation until such time as such use justified the investment necessary to adapt them for permanent tillage Meanwhile such lands may serve a useful and very valuable purpose as forests. Forestry use not only safeguards the fertility of the soil from destruction, but actually contributes to its upbuilding." Mr. Sherman in the above words

might have been speaking for many parts of the British Empire where problems of the kind, through mismanagement or ignorance in the past, are urgently demanding a solution

At the quarterly meeting of the Grand Council of the British Empire Cancer Campaign held on Monday, April 8, the summary of the recommendations made by the Committee of the International Cancer Conference held last July was passed to the Investigation Committee of the Campaign to take action in initiating executive action on the proposals. In the matter of radium and X-rays, the Committee stresses the necessity for the institution of standardised records of results of patients treated by radium and X-rays, and urges that the Campaign, in collaboration with the Medical Research Council and the Ministry of Health, should invite all institutions using radium and X-rays to utilise an agreed form of record The Grand Council received the final reports on the subject of the Garton Prize, which has been instituted by the British Empire Cancer Campaign for the purposes of promoting investigations into the nature, causes, prevention, and treatment of cancer. It was announced that a medal, with an honorarium of £500, will be awarded to the person, or group of persons, who shall submit the essay embodying the results of original investigations which, in the opinion of the judges appointed by the Grand Council, is the best contribution towards "The Early Diagnosis of Cancer"

The recent presentation by Messrs. Thos. W. Ward, of Sheffield, to the North-Eastern Railway Museum at York, of some old rack rails and wheels from the Wylam wagon way has attracted considerable attention in the Press, and the Wylam wagon way has been referred to as the earliest railroad in the world On such matters there is often confusion of thought, and it should be remembered that railroads existed a very long time before locomotives were introduced. Longitudinal wooden timbers were adopted on roads in mining districts in the fifteenth century and their use in the north of England was a factor in the development of our coal industry. By the beginning of the nineteenth century they were in general use, but all haulage was by horses. Cast-iron plates or edge rails were introduced towards the end of the eighteenth century. All such railroads were, however, private concerns, and the first public railroad was the Surrey Iron Railway, which was completed to Croydon in 1803 and to Merstham in 1805, but was never carried as far as Portsmouth, which was its intended destination. The Wylam line is of course bound up with the introduction of the steam railway about ten years later.

In a paper read to the Newcomen Society on Mar. 27, Mr. W. A. Benton dealt with the subject of weighing heavy loads, and especially with the invention of the compound lever machines by John Wyatt of Birmingham. Peoples of oriental or classical antiquity possessed no other weighing machines except those of the equal-armed balance and the steelyard, and the maximum capacity of such machines during the Middle Ages does not appear to have exceeded one or two tons. One such high-capacity wooden beam has survived at Neisse, in Prussia. The claims sometimes made that the compound-lever weighing machine was first used by the Italian physician, Santori Santoria (1561–1636) do not appear to be substantiated, though he introduced the practice of weighing his patients During the eighteenth century huge steelyards were introduced for weighing loaded carts, two specimens of which still exist in England, one at Soham, Cambridgeshire, and the other at Woodbridge, Suffolk. Wyatt's invention was made about 1744, and the machines with compound levers are described in encyclopædias at the end of the century. An examination of the Wyatt manuscripts, however, Mr. Benton said, failed to throw much light on the early history of Wyatt's invention, which forms the basis of all platform weighing machines to-day. A carpenter by trade, Wyatt was born near Lichfield in 1700 and died on Nov 29, 1766, his tomb being in the churchyard of St. Phillip's, Birmingham Mr Benton was able to illustrate his paper with lantern slides and models, some of the latter coming from the historical museum of Messrs W. and T. Avery, Ltd., Birmingham, whose works occupy the site of Boulton and Watt's famous Soho Foundry.

American museums continue to make great advances in their efforts to reach and teach the people In connexion with the Brooklyn Children's Museum, a new building—larger and finer than many of the local museums of Britain—has just been opened to the public, and the increase of space has suggested many improvements in the storing and lending of material The library section, in addition to its books which are open to inspection by the children, possesses 8000 lantern slides catalogued on the Dewey system, a file of 5000 pictures so indexed that any teacher or child may borrow a set of them for special school work, and a collection of excerpts from the *National Geographic Magazine*, arranged according to subject and also available for borrowing It is still more interesting to learn that from the hall in which the Hooper Memorial Loan Collections are displayed children may borrow and take home small cases containing mounted birds, which they take off the shelves just as they might borrow a book. A new type of history room is to be created at the Brooklyn Children's Museum as the result of a gift of 15,000 dollars by Mrs. John Mills. The room will contain a unique collection of twenty-five historical scenes in miniature, illustrating significant events in the progress of the human race. They will begin with the cave men and will show that ideas, rather than wars and weapons, have been responsible for the progress of mankind. Further groups will tell of the discovery of painting, the development of the drama, the science of navigation, the application of steam and electricity, and the conquest of the air. Mr. Dwight Franklin, of New York, who is already well known for this class of work, will prepare the historical groups, and it is expected that the creation of the twenty-five groups will occupy about two years.

In paper mills and rubber factories trouble often arises from large sparks due to the statical electricity

generated by the running machinery. Various remedies have been suggested for reducing the fire risk due to this effect. In a recent *Daily Science News Bulletin*, issued by Science Service of Washington, D C, a somewhat novel method used by a large Russian rubber factory is described for avoiding the danger of fire. In the factory, when the rubber solution flows over the fabric base and dries on it, large charges of static electricity are produced by the friction of the rubber-covered fabric with parts of the drying machinery When the stress at the surface gets greater than the electric strength of air, a hot 'fat' spark is produced similar to the ignition spark of a magneto, and this may start a fire, or cause an explosion as the air in the drying room is always saturated with highly explosive vapours. A usual method in Great Britain is to use a fine wire brush to collect the charges and let them pass to earth, but sparks cannot be altogether prevented in this way. In the Russian State factory in Leningrad a capsule of radium is placed near the point where the electricity is generated. The radiations from the radium ionise the air, and so the electric charges flow through it harmlessly to the earth The cost of the installation is very low, as one milligram of radium is quite sufficient to prevent sparks from taking place, and it will doubtless last for many years. The method has been known for a long time, but this industrial application is a useful one.

THE first Young Farmers' Club in Great Britain was formed by United Diaries, Ltd., at Hemyock in Devon in 1921, and from the start the movement has been remarkably successful. Whereas in 1924 there were only about 30 clubs and 600 members, now there are 100 clubs with a membership of about 2000. A fresh indication of enterprise is the recent issue of a monthly illustrated journal entitled *The Young Farmer* (National Association of the Young Farmers' Clubs, 26 Bedford Square, London, W.C.1; price 3*s.* a year). Much interesting information is given in the first issue by various authors concerning the aims, growth, and activities of the movement. From the outset it was realised that though it was ideal for the organisation to be independent and self-supporting, yet some outside help would be necessary for a start In 1924 the Ministry of Agriculture accepted a measure of responsibility, and now the support of the National Council of Social Science has been secured; and a National Association of Young Farmers' Clubs has been formed under its auspices. Such centralisation, together with the help of the new journal, should do much towards creating corporate feeling between the individual clubs. Titles of articles in the first issue, such as "My Experiences at the Dairy Show in 1928," "Coaching an International Cow Judging Team," "Boys and Girls in Rural Ontario," "A Year's Work in a Bee Club," serve to indicate the varied nature of the contents.

THE considerable extension of fur-farming in Great Britain during the last few years suggests that the attention of inquirers should be directed to a leaflet just issued by the United States Department of Agriculture, "Recommendations to Beginners in Fur-farming." In gives in summary form, with references to further literature, general information on how to make a start, areas suitable for farming, species suitable for propagation, where to obtain breeding stock The instruction is scanty, but it may be readily supplemented by consultation of the special publications of the Department, which are mentioned.

THE Czechoslovak National Research Council, which is incorporated in the International Research Council, concluded its fifth year's activity at a general meeting held in Prague on Mar 16 The president, Prof. Syllaba, opened the meeting by defining the functions of the International Research Council and the Czechoslovak National Research Council, which latter is an offspring of the Czech Academy of Sciences. In conclusion, Prof. B. Němec delivered an interesting lecture on "International Aspects of Czech Science," in which he pointed out the twofold duties of scientific workers of a small nation, namely, to cultivate their national science and to present their achievements before the international world The annual report, which has recently been published, describes the activities of the ten sections of natural sciences, medicine, and engineering, and gives the names of the 82 members.

BY an Act of Congress the United States of America have established a Gorgas Memorial Institute of Tropical and Preventive Medicine in Panama, and the memorial laboratory has just been opened. Surgeon-General William C Gorgas, who died in 1920, went to the isthmus of Panama to report on the sanitary conditions of the Canal Zone in 1904; he was appointed chief health officer for the region, which was then notorious for malaria and yellow fever. His work there, a monument to scientific and administrative hygiene, made the Canal Zone an inhabitable and even healthy area. The first director of the new laboratory is Dr Herbert C. Clark, who was with General Gorgas in the Canal Zone for several years. Congress has authorised a permanent appropriation of 50,000 dollars a year for maintenance, and Latin-American governments have been invited to contribute up to 75 per cent of the amount given by the United States.

THE Bureau for Contraceptive Advice, Baltimore, Maryland, has issued its first statistical report, compiled by Prof. Raymond Pearl. The number of women (all married), attending was 168, their average age was just under 31 years, and the average duration of marriage 12·3 years One-half of the women who attended the Bureau had been pregnant more than six times and had borne five or more children before they came. Such reproductive rates are not conducive to either private or public health, and the figures given demonstrate the value of such a clinic as a health measure and lend no support to some of the objections that have been advanced against contraceptive measures.

A LEADING article in the latest number of. the *Scottish Naturalist* entitled "More Opportunities for

Naturalists. Natural History as a Profession," points out the need for the creation of trained biologists to fill the increasing number of posts available in Great Britain and its colonies "There never has been a time when so many opportunities offered themselves for young men who desire to follow natural history as a career, nor a time when so few men could be found to fill the posts that await them" It is shown that the posts in question cover a wide variety of work, giving scope for outdoor observation and opportunities for biological research, and an indication is given of the scales of salary which may be expected here and abroad.

The "Report on the Health of the Army" for the year 1927 has recently been issued (London. H.M.S.O.). The incidence of sickness among soldiers during the year was somewhat higher than that of the preceding year, being 467·7 per 1000 of the strength, accounted for by the high incidence of infection during the early months of the defensive occupation of Shanghai. The principal causes of admission to hospital were malaria, 9265 cases, venereal diseases, 9186 cases, and inflammation of tonsils, 6322 cases. The high incidence of tonsillitis still remains unexplained. As in the previous year, inflammation of the middle ear heads the list as cause of invaliding. Diphtheria was comparatively prevalent with 317 admissions, while the enteric groups of fevers numbered only 239 cases for the whole army, including India, a remarkable record

Prof Pieter Zeeman, of the University of Amsterdam, has been elected an honorary fellow of the Physical Society of London

The George Darwin Lecture of the Royal Astronomical Society will be delivered at the meeting of the Society on May 10, by Prof. E. Hertzsprung, who will take as his subject "The Pleiades."

Prof. F. O. Bower, emeritus professor of botany in the University of Glasgow, will give the Huxley Memorial Lecture at the Imperial College of Science and Technology, London, S.W. 7, on May 3 at 5.30 P.M. His subject will be "The Origin of a Land Flora reviewed Twenty-one Years after Publication"

The fourteenth Guthrie Lecture will be given before the Physical Society by Prof. P. W. Bridgman, Hollis professor of mathematics and natural philosophy in Harvard University, on the properties of the elements under high pressures, at 5 o'clock on April 19, in the Imperial College of Science, Imperial Institute Road, South Kensington. Admission is free without ticket.

It was announced by the president of the Linnean Society of London, at the meeting held on April 4, that the Linnean Medal, which "is awarded each year to an eminent biologist as an expression of the Society's estimate of his services to science," is to be given to Prof. Hugo de Vries, the veteran emeritus professor of botany in the University of Amsterdam, who is best known for his mutation theory of the origin of species.

The gold medal of the Institution of Mining and Metallurgy has been awarded conjointly to the Hon. William Lawrence Baillieu and William Sydney Robinson "in recognition of their services in the development of the mineral resources of the Empire, with special reference to the zinc and lead industries of Australia" The medal (in duplicate) will be presented at the annual general meeting of the Institution to be held at Burlington House on Thursday, May 16.

The following office-bearers were elected at the meeting of the Royal Philosophical Society of Glasgow on Mar 27:—*Vice-President* Mr. Robert A. Burr; *Members of Council* Prof. E. P. Cathcart, Dr. James W. French, Mr. Thomas Henderson, Mr. Andrew A. Mitchell, *Hon Treasurer* Sir John Mann, *Hon. Librarian* Dr. James Knight, *Hon. Secretary*. Dr. Charles R. Gibson, *Hon. Auditors* Mr Alex. Murdoch, Mr John T Tulloch; *Acting Secretary*: Dr. James M. Macaulay.

A special feature of the first annual conference of the International Society of Experimental Phonetics, to be held at Hamburg on July 24–31, will be the provision for practical demonstrations and exercises in the study of speech by the graphic method. Each participant will have an opportunity of becoming familiar with this method of investigating language, dialects, speech defects, the speech of the deaf, and nervous diseases. This method is that of the Abbé Rousselot with the later improvements Information concerning the conference can be obtained from Prof. E. W Scripture, Strudelhofgasse 4, Vienna.

At the annual general meeting of the Ray Society held on Mar. 21, the following officers were re-elected: *President*. Prof W C M'Intosh; *Treasurer* Sir Sidney F. Harmer, *Secretary* Dr. W. T. Calman. Dr. R W. T. Gunther was elected a vice-president, and Mr. R. Adkin and Mr R. Gurney were elected new members of council In the report of the council it was announced that the third and final volume of the "British Hydracarina," by Mr. C. D Soar and Mr. W. Williamson, would shortly be published, and that the issue to subscribers for 1929 would be a volume on "The Planktonic Diatoms of Northern Seas," by Dr. Marie V. Lebour. A work on "The Aquatic Stages of British Dragonflies," by Mr. W. J. Lucas, was announced as being in preparation for publication at a later date.

Among recent appointments in scientific and technical departments made by the Secretary of State for the Colonies are the following Mr G N Herington has been appointed agricultural instructor in the Education Department, Nigeria. Mr. A. W. Anderson, recently one of the Ministry of Agriculture and Fisheries' advisory officers, is to be a superintendent of agriculture, Nigeria, and to take charge of the new stock-breeding farm at Samaru. Mr. D. A. Langdon has been appointed a produce inspector, Nigeria, and Mr. T D. Lloyd-Jones a veterinary officer in the same Colony. Mr. N. R. Reid has been appointed a veterinary officer in Tanganyika Territory. Among the recent transfers and promotions are the following. Mr J. R. Ainslie, senior conservator, to be deputy director of forests, Nigeria, and Mr. C. F. Vetch, conservator of forests, Nigeria, has been appointed to succeed him as senior conservator. Mr.

D. D'Emmerez de Charmoy, assistant director, has been appointed director of agriculture, Mauritius

MESSRS. BERNARD QUARITCH, Ltd., 11 Grafton Street, W.1, have just issued an important catalogue (No. 424) of some 1800 works relating to science, mainly of zoological and geological interest. As is usual with lists circulated by this house, many rare items and long runs of serials are included. The catalogue is one that should interest collectors and librarians.

THE new catalogue of engineering and industrial instruments issued by Messrs. Negretti and Zambra is a well-illustrated quarto volume of 460 pages. It deals to a large extent with thermometers of all kinds, from spirit thermometers to electrical thermometers, suitable for near or distant stations, and gives a considerable amount of very useful information about the principles on which they work and the precautions necessary in setting them up and caring for them in use. Barometers, pressure gauges, tank gauges, hydrometers, and hygrometers receive similar treatment and a thumb index facilitates quick reference

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —Temporary assistant quantity surveyors under the Mines Department—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W 1 (April 18). An assistant bacteriologist for the city of Liverpool—The Town Clerk, Municipal Offices, Liverpool (April 22) A temporary assistant bacteriologist for research in fabric materials—The Secretary, Admiralty (C.E. Branch), Whitehall, S.W 1 (April 27). An education secretary for the borough of Cambridge—The Town Clerk and Clerk to the Local Education Authority, The Guildhall, Cambridge (April 27). A chief assistant and two other assistants for the Scottish Society for Research in Plant-Breeding under the Society's scheme of research into virus disease of potatoes—The Secretary, Scottish Society for Research in Plant-Breeding, 3 George IV. Bridge, Edinburgh (April 30). A lecturer in education in the University of Sheffield—The Registrar, The University, Sheffield (April 30). A lecturer in mathematics at the Heriot-Watt College, Edinburgh—The Principal, Heriot-Watt College, Edinburgh (May 1). An assistant at the Commonwealth of Australia Solar Observatory, near Canberra —The High Commissioner for Australia, Australia House, Strand, W.C.2 (May 2). A junior technical officer at the Royal Aircraft Establishment, to assist in the experimental development of electrical equipment for use in aircraft—The Chief Superintendent, R.A. Establishment, South Farnborough, Hants (May 3). A principal of the Paisley Technical College —The Secretaries of the College, 3 County Place, Paisley (May 3) A demonstrator in physics, a demonstrator in zoology, and a demonstrator in inorganic and physical chemistry at Bedford College for Women—The Secretary, Bedford College for Women, Regent's Park, N W 1 (May 4). A director of museums of the City of Liverpool—The Town Clerk, Municipal Offices, Liverpool (May 7). A professor of zoology in the Egyptian University, Cairo—The Dean of the Faculty of Science, Egyptian University, Cairo (May 19). A laboratory assistant at the College, Cheltenham—The Senior Science Master, The College, Cheltenham.

Our Astronomical Column.

THE APRIL METEORS.—These meteors are due on April 20 or 21, but the moon, being full on April 23, will be a bright object at the time and obscure small meteors. However, the shower occasionally exhibits brilliant objects, so that it may be well worth looking for though the character of its display this year cannot be definitely foretold. The period of revolution of its supposed parent comet was computed to be more than 400 years, but rich showers of Lyrids were witnessed in 1803, 1851, 1863, and other years, so that a short period apparently corresponds with some of the most abundant returns of the meteors. It is important to note the strength of the annual displays, so that the time of revolution of its more active returns may be determined. Its radiant is at 271° + 33° on the night of maximum, but the centre of radiation travels eastwards one degree per day.

THE NUCLEI OF PLANETARY NEBULÆ—Mr. van Maanen deduced the trigonometrical parallaxes of a number of nuclei of planetary nebulæ from photographs taken at Mt Wilson. He derived the mean parallax 0·012″, and the mean absolute magnitude 8·1 for the nucleus. Mr B. P. Gerasimovic notes in *Harvard Bulletin* No. 864 that such data as exist for the proper motions and radial velocities of the planetary nebulæ indicate a considerably greater mean distance than that found by van Maanen. He makes several different estimates of their mean distance; (1) by their mean galactic latitude, which is assumed to be due to the sun's departure from the galactic plane, (2) by applying Oort's results on galactic rotation, (3) by using the analogy between the nebular nuclei and novæ, (4) by combining the proper motions found by van Maanen with the mean radial velocity of planetary nebulæ found at the Lick Observatory, which is 37 km./sec. The mean absolute magnitudes found by these methods are 4 3, 4 6, 4·0, 5·9 respectively the weighted mean is 4·9, which is more than 3 magnitudes brighter than van Maanen's value, there is therefore good reason for thinking that his parallaxes for these objects are four times too large, though no explanation of this error has been found

THE ORBIT OF ETA CORONÆ—*Astr. Nach.* 5615 contains an exhaustive study of the orbit of this star by E. Silbernagel, who has devoted himself for some years to the re-determination of the orbits of binaries. The duplicity was discovered in 1781 by Sir W. Herschel, and as the period is less than 42 years, 3½ revolutions have been completed since then. About 500 observations are employed, and the personal equations of the observers are determined. The following is the final orbit:

T	1892·385	n	8·6490°
Ω	23·717°	a	0·907″
i	59·025		
ω	219·907	Period 41·623 y.	
e	0·2763		

Research Items.

FESTIVALS OF THE HOS OF KOLHAN.—Mr. D. N. Majumdar describes in the *Journal and Proceedings of the Asiatic Society of Bengal*, N.S., vol. 23, No. 3, the seven important worship festivals of the Hos which take place at different seasons of the year. It is noteworthy that in certain feudatory states in Orissa, where the Hos live in close association with the Oriya-speaking peoples, while the latter take part in the festivals of the Hos, they are not allowed to take part in their dances, when men and women mingle freely, as intermarriage is not allowed. The festivals are not held at fixed dates, but depend upon economic conditions. When the granaries are full and the Hos are free from other engagements, the priest fixes a day for a festival, each village deciding for itself, so that any given celebration may extend over as much as two months, when the whole area of Kolhan is taken into account. The principal festival is the Maghe, which is held in January and February. Its meaning is obscure, but it seems to be connected with fertility. All villagers, even if working in remote districts, must return to take part. It entails five days of ritual observances, with *pujas* and sacrifices to the village deity. On the first day the sacrifice is connected with the cattle, on the second rice-beer is offered by the priest and his wife. The third day is purificatory, in preparation for the marriage festival of the fourth day, which is the main function of the celebration. On this day the priest is escorted to take a ceremonial bath. He then sacrifices a cock and hen. A second hen, which is offered to the god, is not sacrificed by the priest, but is stoned to death by the villagers. In the dance which follows obscene songs are sung and obscene practices observed for the purpose of increasing the procreative power of the tribe. On the fifth day the expulsion of spirits takes place, when the villagers arm themselves with sticks, four or five feet long, and hunt the spirits throughout the village with invocations which are unintelligible even to themselves.

EARLY PERSIAN ZOOLOGY.—The earliest exposition of Persian zoology is contained in a compendium of science, the "Nuzhatu-i-Qulûb," written by Mustaufî about A.D. 1340. One of the few extant zoological treatises of the Islamic East, apparently the only one the primary object of which was scientific rather than literary or philological, its chapters are of much interest as illustrating the level of zoological knowledge at the time, and indicating the sources from which that knowledge sprung. In a learned treatise upon the subject (*Isis*, vol. 11, December 1928), Dr. John Stephenson traces the influences which are apparent in Mustaufî's zoology, gives examples of the treatment of real and fabulous zoology, of the bearing of the work upon medicine, and of the surgical uses of animals and their several parts. In an interesting comparison with European zoological works of the same period, he points out striking resemblances with the zoological text-book of Christianity in medieval times, the "Physiologus," and, since direct borrowing may be ruled out of the question, he regards these similarities as due to the descent of tradition from a common source. The general level of knowledge is much the same as that displayed by the thirteenth-century English Franciscan, Bartholomew de Glanvilla, who borrowed from the "Physiologus," and, like the Persian author, had his mythical creations, mermaids, fauns, and satyrs, as well as more realistic monsters, such as the omocentaur, offspring of the bull and the ass.

EVOLUTION OF HUMAN TOOLS.—An unusual study in human evolution has been made by Mildred Fairchild and Dr. Hornell Hart (*Scientific Monthly*, January 1929), in which they trace in a general way the development of cutting tools from the earliest chipped flints to the machines of the present day. The existence of such tools from the early stages of man's development affords the longest and most complete series of data available for the estimation of man's cultural progress. The tools present five variables upon which efficiency depends: (1) keenness and durability of the cutting edge, (2) differentiation and specialisation, (3) effectiveness of mechanisms employed to apply the blade to the materials to be cut, (4) utilisation of auxiliary power, and (5) mastery displayed in the technique of manufacture. Reducing these elements of efficiency to a numerical basis, and combining all in a graph of progress, the authors produce a curve which, showing little rise over a long period, makes a sudden and rapidly increasing ascent during the past 8000 years. Whereas in earliest times thousands of years indicated the unit of progress, now each decade or each year shows swift advancement. The more and more rapid acquisition of new elements is not due to our lack of knowledge of early portions of the series; the increasing speed of invention is an unmistakable feature of the series itself.

BIRDS OF INNER LONDON.—Much has been written about the birds of London, and the lists published by the committee in charge of the bird sanctuaries in the Royal Parks furnish useful notes on fluctuations of species from year to year. But no attempt has hitherto been made to compile a complete list of the birds which have been seen in Inner London as a whole. The area selected by A. Holte Macpherson for his interesting article on the subject (*British Birds*, March 1929) extends 2½ miles due north and south of Charing Cross and 4 miles due east and west of that point. Within this district the author is able to record a list of 126 species, of which 21 breed regularly, 8 others have been known to breed during the present century, and the remainder are visitors, 20 of which may be regarded as regular and 77 as putting in only an occasional appearance. Perhaps the most striking feature of the list is the variety of ducks and waders recorded. The occurrence of such as whimbrel, common and jack snipe, and woodcock, and of gadwall, scaup, and scoter, suggests that the mud-banks of the Thames at low water may yet reveal further additions to the list, now that so satisfactory a basis has been laid for future observations.

NEW AQUATIC RODENT FROM AFRICA.—Until the expedition organised by the Field Museum and the *Chicago Daily News* returned from its explorations in Abyssinia, only one aquatic rodent was known from Africa, namely, *Dasymys*. Now a second murine rodent, with rather pronounced aquatic modifications, has been found in a small mountain stream near the source of the Blue Nile. Its adaptations more closely resemble those of aquatic rodents in other parts of the world than of *Dasymys*, and since it shows no special affinities to the latter, the two African 'water-rats' probably had independent origins. For this outstanding form Wilfred H. Osgood has created a new genus and species, *Nilopegamys plumbeus* (*Field Mus. Nat. Hist.*, *Publication* 250, November 1928). Its particular adaptations for aquatic life are mainly in the character of the fur, the reduction of the external ears and the enlargement of the hind feet;

and in these respects it is reminiscent of the South American *Ichthyomys*, to which also it bears some resemblance in its skull. But the skull is not greatly modified and the suggestion made is that the new 'water-rat' may have been derived at no very remote period from one of the common types widely distributed in central Africa

GRAFTING EXPERIMENTS IN TWO-DAY CHICKS.—P. D. F. Murray (*Aust. Jour. Exp. Biol*, vol. 5, part 4, Dec. 1928) has made chorio-allantoic grafts of lateral pieces of two-day chicks, taken from the region forming the posterior limb by making an anterior transverse cut posterior to the hindmost somite then formed, a posterior cut in front of the anterior end of the primitive streak, a longitudinal median cut lateral to the vertebral plate. The grafts show cartilaginous structures interpreted as attempts at limb-formation, and it is concluded that no essential influence is exerted by the somites on the development of limbs, and the author adduces reasons for the view that if the limb rudiment at two days could be completely isolated self-differentiation would occur, that is, the rudiment of the hind limb is already determined at this stage. The nervous system exerts no essential influence on the development of the limbs of the chick. In three cases the endodermal and splanchnopleural components of the grafts have given rise to short pieces of intestine with epithelium, corium, circular and longitudinal muscle layers, hence small pieces of the region of the alimentary tract are able to develop in the absence of the other regions of the tract.

INTESTINAL MUSCLE OF THE CRANE FLY—S Maziarski (*Bull Int Acad. Polonaise Sc. Lettres*, 7 B, 1928) has investigated the histology of the muscle of the alimentary tract of several species of *Tipula* (crane fly). Opinions as to the nature of the muscular elements—whether they are smooth or striated—have been contradictory, but the author states that undoubtedly all the muscular elements of the intestine are in the category of striped muscle. All the contractile elements and their ramifications by which they anastomose exhibit a characteristic longitudinal and transverse striation, the longitudinal due to the myofibrillæ in the sarcoplasm The elongate muscular elements, each with a single nucleus and a sarcolemma sheath, exhibit numerous ramifications either terminal or lateral, some short and others apparently composed of a single myofibril, which anastomose directly with neighbouring fibres to form a network. The anastomosis always takes place at the level of the membrane of Krause, which confirms the view already expressed by many other histologists that this is distinct from the contractile substance and represents a more plastic and more resistant supporting material. The intimate relations between the fibres (cells) suggest that the contractile elements have lost their individuality and form a muscular syncytium

COTTON—The reports received from experiment stations during 1927–28 have been issued by the Empire Cotton Growing Corporation in a bulky volume of some 270 pages, plus photographs, diagrams, etc. This lengthy document is preceded by a very valuable, concise summary of its contents by Dr. J C Willis. Dr. Willis points out the inevitable difficulty of the field experimenter in that his rainfall practically always departs from the average (and the same may be said of every measurable climatic factor), and thus in the twenty climatic records from ten cotton experiment stations in the last two seasons, five may be classed as good years, ten medium, and five bad. Some experiment stations are probably situated in climates which are not well suited for existing varieties of cotton, and here, as at Fiji, where the weather is probably unusually wet for cotton, something may be done by hybridisation and selection to produce a new variety more suitable to the climate. In South Africa, the immediate problem has been the production of a variety showing resistance to the jassid pest, and remarkable progress appears to have been made with the selection and multiplication of suitably resistant strains. These strains, developed at the Barberton Station, seem likely also to be successful in Rhodesia. In Queensland good progress seems to have been made in dealing with the pink boll-worm, whilst in Fiji it is very interesting to learn that the boll-worm pest is apparently kept in check by its parasitic enemies. Boll-shedding before the crop is mature is often a great source of trouble with cotton, and in Uganda definite progress seems to have been made with the breeding of varieties with lower rates of boll shedding. All who are interested in any phase of the field study of the cotton plant, its growth, the control of its parasitic enemies, the breeding of new strains, etc., will find the Report of interest and value It is published by the Empire Cotton Growing Corporation, Millbank House, Millbank, London, S W.1.

GLADIOLUS.—The wide range of species of *Gladiolus* in South Africa is illustrated to some extent in the beautiful coloured plates accompanying the article by Mrs. Bolus on this genus in the *Journal of the Botanical Society of South Africa*, part 14, 1928. In the notes on p 3 of the same journal, attention is directed to the horticultural possibilities that are suggested by experiments in hybridisation with some of this species. Thus at present there are no scented and no blue forms among the *Gladiolus* hybrids under cultivation, whilst amongst the South African species blue-flowered ones occur and some of the wild species have a powerful and delicious fragrance. Such hybridisation experiments would seem very suitable work to be carried out at the National Botanic Gardens, Kirstenbosch, but unfortunately the income of the Gardens does not permit the possession of any scientific or technical staff whatever, so that such experiments in the Gardens could only be carried out to the detriment of other work. In the same number of the journal, Mr. J. W. Mathews, curator of the Gardens, contributes some notes on the cultivation of the native South African gladioli

NEW PROJECTION FOR WORLD MAPS.—In the *Geographical Journal* for March, Mr. S. W. Baggs describes a new equal-area projection that should be useful in statistical maps. It is an equal-area projection which is an arithmetical mean between the sinusoidal equal-area projection of Sanson and the elliptical equal-area projection of Mollweide Inequality in linear scales near the equator is scarcely noticeable, and the same is true between latitudes of, say, 60° and 75°. This feature is an improvement on Mollweide Angular distortion is less than in Sanson in latitudes below 62°; above 68° or thereabout the angular distortion is less than in Mollweide The author describes it as a 'eumorphic equal area projection' He points out that this projection, like those of Sanson and Mollweide, having straight parallels and converging meridians, lends itself to 'interrupted' construction in gores or lobes which much enhances its value for distributional maps

EARTH MOVEMENTS IN CALIFORNIA.—The United States Coast and Geodetic Survey is continuing its researches into earth movements in the western United States by comparing the position of stations as determined by old and new triangulation. In *Special Publication* No. 151, Dr. W. Bowie discusses the results

of recent work in California. The comparison is generally between determinations made prior to 1900 and those made between 1922 and 1925. Many stations show no movement. The greatest movements have occurred close to the fault line of the earthquake of 1906 Stations more than twenty miles from the fault were affected but only slightly The differences are small and seldom exceed one metre The trend of the changes is to the south-eastward, on the east of the fault where they are most noticeable Dr. Bowie suggests that investigations of this nature should in the future be done by means of short arcs of triangulation extending across the fault line or zone to a distance of about twenty-five miles on both sides. The accuracy can be made great enough to detect movements of about one-tenth of a foot in a mile. He prefers this method to that of measurements between monuments placed across the fault zone in a straight line. This plan involves the difficulty of measuring with tapes over broken ground

Indian Jurassic Ammonites.—The third part of Dr. L F. Spath's "Revision of the Jurassic Cephalopod Fauna of Kachh (Cutch)" (*Palæont Indica*, N.S., vol 9, mem 2, pp. 163-278, plates 20-47, 1928) deals with the super-family Stephanoceratidæ, represented by about 500 specimens This is divided into five families: the Macrocephalitidæ with 7 genera, the Eucycloceratidæ with 4 genera, the Pachyceratidæ with 2 genera; the Mayaitidæ with 5 genera; and the Reineckeidæ with 6 genera

Japanese Palæontology.—The rich fauna of the Lower Tertiary of the island of Kyûshû, Japan, has been described by T Nagao (*Sci Rep Tôhoku Imp Univ. Sendai*, ser. 2, Geol 12, 1, 1928, pp 11-140, plates i-xvii) It consists mainly of lamellibranchs and gasteropods, but some foraminifera, echinoids, nautiloids, crabs, and fishes are also found Three horizons are recognised. The lowest is regarded as Ypresian or Lutetian in age; the middle as Upper Eocene, the upper as Oligocene In the same publication (pp. 141-152, plates xviii-xxiii) H. Yabe and S. Toyama give an account of the rock-forming algæ from the Jurassic and Cretaceous deposits of Japan Some of the species are referred to genera found in England (*Girvanella, Solenopora*); others belong to new genera.

Vacuum Technique.—Several attempts have been made to find a substitute for mercury for use in high-vacuum pumps, but they have not hitherto met with any conspicuous success, metals other than mercury have undesirable properties, and it had been thought that organic substances were too liable to decomposition to be of use. C. R. Burch, of the Metropolitan-Vickers Company, states, however, in the issue of the *Proceedings of the Royal Society* for Mar 6, that it is possible to run a condensation pump satisfactorily with some of the fractions obtained in the vacuum distillation of petroleum jelly, when both the speed of pumping and the degree of vacuum reached compare favourably with those obtained when mercury is employed. The petroleum products have the additional advantage that their vapour pressures are decidedly less than that of mercury at room temperatures. The author has also isolated a number of greases, the vapour pressure of which is less than a microbar at 300° C., which should be extremely valuable for the lubrication of ground joints in vacuum apparatus which does not require to be heated.

Stark Effect.—Prof. Stark's discovery of an electrical analogue of the Zeeman magnetic effect for spectral lines, although less widely applied in spectrum analysis, has recently become of importance in connexion with the wave-mechanics The distribution of intensities in the Stark patterns for the Balmer series of atomic hydrogen has been predicted by Schrodinger, and experiments to test his theory have now been made by J. S Foster and L Chalk (*Proceedings of the Royal Society*, Mar 6), and by H. Mark and R Wierl (*Zeitschrift fur Physik*, Feb. 25) Dr Foster has made use of the natural electric fields in the cathode dark space of a discharge tube, and finds distributions of intensities which agree with those predicted by theory. The other investigation was made upon the light emitted from a beam of positive rays passing through an auxiliary electric field, and the agreement between theory and experiment is less good The origin of these discrepancies is not clear, but it may be, as H Mark and R Wierl suggest, that the experimental conditions employed do not conform completely with those contemplated in the theoretical analysis. Dr. Foster has contributed a second paper, on the Stark effect in neon, to the same issue of the *Proceedings*, which also contains a paper by J. K L MacDonald on the Stark effect for some lines in the violet part of the secondary spectrum of hydrogen

Combustion of Carbon Monoxide.—Prof. W A Bone's experiments on the combustion of dry mixtures of carbon monoxide and oxygen have been subjected to a certain amount of criticism on the grounds that inadequate precautions had been taken to remove occluded hydrogen from the platinum electrodes between which the igniting spark was passed These objections appear to have been met satisfactorily in the reply which he has published in the issue of the *Proceedings of the Royal Society* for Mar 6, and some new experiments which are described there, in which the drying was, if possible, even more drastic than before, confirm his earlier result that the intensively dried mixture can be induced to react if only sufficient energy is supplied to initiate the explosion wave. Prof. Bone and his collaborators consider that the limit of intensive drying by phosphorus pentoxide is reached in about six months in small glass vessels such as those they have employed. The energy required to start the explosion seems to depend both upon the nature of the electrodes used and upon the composition of the detonating mixture, but the numbers which are mentioned in this paper are all in the neighbourhood of one joule.

Action of Acetylene on Selenium.—Only very few accounts of experiments on the direct action of non-metallic elements on organic compounds have as yet appeared in chemical literature. The formation of thiophthen, $C_6H_4S_2$, by the interaction of acetylene and molten sulphur was observed by Capelle and confirmed by Oechsner de Coninck (1908), whereas, according to Meyer and Jacobson's "Lehrbuch," Sandmeyer established the formation of thiophen under such conditions In the *Rendiconti* of the Naples Academy of Physical and Mathematical Sciences for September–December 1927 (just received), Mazza and Solazzo give the results of an investigation on the action of acetylene on selenium. Passage of the pure, dry gas over selenium heated to 250°-300° C yields an oily product, which may be resolved by fractional distillation into two compounds: (1) Selenophen, C_4H_4Se, b.pt. 113°-114°, which is identical with the product obtained by Foà in 1909 by the action of phosphorus selenide on sodium succinate, (2) a new compound, selenonaphthen, C_8H_6Se, m.pt. 53°-54°, b pt. 207°-209°, which is the selenium analogue of thionaphthen and has an intensely nauseous odour. This compound crystallises well and forms a golden-yellow, crystalline, slightly soluble picrate.

Research on Water Pollution.

A COMMITTEE has been set up, under the chairmanship of Sir Horace Monro, to deal with the legislative and administrative aspects of questions relating to river pollution. This committee considers that present legislative enactments are sufficient, and recommends the setting up of River Boards in the various watersheds of England. Such Boards, having a call upon the rates, would be in a financial position to apply the laws against pollution, a costly activity which rarely appeals to private individuals. They would be in a position to employ a technical adviser conversant with local conditions and with known means of dealing with noxious effluents. It remains to be seen whether county councils will act on this advice and set up a series of Boards throughout Great Britain, similar to that in the West Riding of Yorkshire.

Although much has been done recently in surveying rivers and locating sources of pollution, many of which could be stopped or at least ameliorated without putting undue burdens upon the rates or upon individual industries, there are also numerous questions which, in the interests of the public, have still to be worked out.

With this aim in view, the Water Pollution Research Board was formed in June 1927, with Sir Robert Robertson as chairman and Dr. H. Calvert, chemical Inspector of the Ministry of Health, as part-time director of research. They have undertaken the three-fold task: "To collect and collate all pertinent scientific and technical information, so that it may be readily available for practical application by those who are concerned with water supply and the disposal of polluting liquids; to encourage and co-ordinate relevant scientific research in this country; and to undertake such investigations as are necessary in the public interest and not otherwise provided for."

A good start has been made. The monthly summaries of current literature, of which some seventy copies are distributed, are excellent and will be of material assistance not only to those concerned with water purification and wastes disposal but also to many workers in hydrobiology. In the report of the Board for the year 1927–1928 (H.M. Stationery Office, 6*d.*) an account is given of investigations now proceeding and of plans for the near future.

The disposal of effluent waters from beet sugar factories presents a problem which had early in the year been 'farmed out' by the Ministry of Agriculture and Fisheries for investigation at Rothamsted. Each factory uses some 3½ million gallons of water daily, of which nearly half a million gallons are discharged containing putrifiable matter comparable to 0.2 per cent sucrose. It is found that by sprinkling this water over a biological filter at a rate of 100 gallons per square yard daily, its putresibility is reduced by some 80 per cent. Trial filters were erected at the Colwick factory and filled with different media. Two were seeded with active growth from a sewage filter, but this inoculation had no observable effect on the maturing of the filters. The growth on coarse gravel consisted of thickly matted fungi, while on the finer media the growth was soft and composed chiefly of bacteria; the flora and fauna on the filters differed and were distinct from the flora and fauna of ordinary sewage filters. The purification attained cannot be regarded as sufficient to meet the most exacting requirements, but still better results are expected from the past winter's campaign.

It is anticipated that the effluents may be made fit for re-use in the factory, a practice which is already in operation in some cases, so that the daily discharge into the rivers will be reduced to a reasonable amount for treatment on biological filters.

A biologist has been appointed to work under the direction of Prof. Topley at the London School of Hygiene and Tropical Medicine, on the processes involved in the treatment of sewage by 'activated sludge'. The solids of sewage after aeration become capable of flocculating colloidal matter and removing dissolved organic substances from further volumes of sewage. In doing so the aerated solids, or 'activated sludge,' lose their activity, which can, however, be restored by further aeration. There is, however, little exact knowledge of the process and it is yet uncertain whether it is physico-chemical or the direct effect of micro-organisms. The de-watering and the production of gas from sludge or sewage also engage the attention of the board.

It is considered that a general biological and chemical survey of a typically polluted river would furnish information of general value as well as local information. Such a survey should yield much new knowledge of river conditions generally, of the interaction between the river and the various effluents—their direct or indirect effect upon the flora and fauna. The Tees is suggested as a suitable watershed, the river having been under examination for several years and useful data already collected. Undoubted damage has been done by pollution, but the nature of the damage and the various causes still offer a wide field for investigation.

In all these matters the main part is played by micro-organisms—the unpaid scavengers of every borough. How they are best harnessed to destroy unwanted organic matter most efficiently, and even to break down naphthalene in coke-oven effluents, provide outstanding problems.

Compared with some continental countries, England is behindhand in providing facilities for the general study of freshwater biology and hydrology. These subjects are no longer of academic interest only, for they enter into many economic problems within the Empire. Mosquito control and tropical lake fishery investigations, for example, are in present need of information and recruits, which should normally come from an English freshwater biological laboratory, similar to the marine laboratory at Plymouth, where more than twenty visitors are at times working on varied researches during the university vacations. That the Rivers Pollution Research Board will act as a valuable clearing-house for information is assured. We hope it may encourage the institution of a laboratory for post-graduate workers near pools, lakes, and a river—a facility for which there is a present demand. The study of aquatic life and of the breakdown of organic matter by micro-organisms is not merely of domestic interest.

The Board has also arranged for the investigation of the softening of water by the process in which it is allowed to trickle through beds of natural or artificial zeolite containing sodium in chemical combinations. The sodium is displaced by the calcium and magnesium of the hard water, and the beds are finally rejuvenated by displacing the calcium and magnesium held by them with a solution of common salt. The mode of action of the base-exchanges is very imperfectly understood from the physico-chemical point of view. The process is in extensive use, but is little used by water-supply authorities as yet.

High-Voltage Alternators for the Grid.

THE developments of engineering seem to be unending. The manufacturer craves after mass production and standardisation, but his wishes are seldom gratified The progress of development sooner or later necessitates change. One of these changes was pointed out by Sir Charles Parsons and Mr. J. Rosen in a paper read to the Institution of Electrical Engineers on Mar 21 They give in their paper reasons for thinking that very high voltage generators can be made which can be directly connected with the grid network without the necessity of using transformers. The possibility of making very high voltage alternators has been known for many years. So far back as 1905 the engineers of the Ganz company constructed several 30,000-volt alternators for use in the hydroelectric power station at Subiaco, 34 miles from Rome. Credit must be given to the engineers for this early pioneering work, and the successful running of these machines show that they had overcome the difficulties of insulating these high voltages.

Engineering history often illustrates the change of procedure brought about by new developments In the early days of marine propulsion, for example, the use of step-up gearing between the prime mover and the propeller was a necessity. When triple-expansion reciprocating engines came into use it was found possible to operate without gearing. For modern steam turbines and some types of Diesel engine, speed reduction gears are now necessary. Just as mechanical gear forms the link between the engine and the propeller, so in electrical power distribution at high pressure the transformer has for many years been a necessary link between the generator and the network, and also between the network and the lighting and motor load.

Sir Charles Parsons and Mr Rosen propose to abolish the step-up transformers by using very high voltage generators which can be connected directly with the mains

They point out that the continually increasing size of the generator units now make the conditions favourable to the introduction of these generators They consider the design of a 94,000-kilovolt ampere, 11,000-volt, three-phase generator. In this case the current at each terminal is about 4900 amperes. Much space is required to accommodate the many cables mounted below the alternator terminals in a cable tunnel through the concrete. With so many cables grouped together, difficulties are experienced with the girders which reinforce the concrete The maximum output from the cables also is rarely obtained The authors show that not only are most of these difficulties overcome but considerable economies are also effected by using an alternator of a higher voltage. If the pressure is increased to 33 kilovolts, the output current is reduced to 1640 amperes, and instead of six cables per phase only two are required.

One great advantage of raising the pressure is the reduction in the cost of the leads and switchgear which it effects. In very large units the enormous currents developed are very difficult to control and operation becomes almost impossible. The General Electric Co of Schenectady when designing a 208,000-kilowatt unit for the State line station near Hammond, Ind , found it necessary to reduce the current This was done by raising the pressure from 18 to 22 kilovolts

Details are given by Sir Charles Parsons and Mr Rosen of the design of a 33,000-volt, 25,000-kilowatt alternator which has been working at the Brimsdown power station in north London since August 1928 A very novel feature in the design is the use of triple-concentric mains for the armature conductors. By this means they are able to reduce the maximum electric stresses to which the dielectric would otherwise be subjected This formation of conductor also is mechanically very strong. The three conductors are called the 'bull,' 'inner,' and 'outer' respectively The bull conductors of each phase are connected in series, they are then connected with the 'inners' in series and finally with the outers. The whole arrangement is connected in star and the star point is connected with the earth.

The test results obtained with this machine were very satisfactory The shape of the voltage wave was practically the same as that of a sine curve. The machine when running at its normal speed of 3000 revolutions per minute was suddenly short-circuited The short-circuit current was less than five times the normal full load current. It seemed to function satisfactorily under these conditions, the end conductors showing no sign of having moved mechanically. The efficiency on a load of 25 kilowatts was 96·5 per cent Even when the load was so low as 10 kilowatts the efficiency was 93·5 per cent. For the last six months it has operated continuously up to its maximum load at voltages varying from 34 to 35 kilovolts, and it has withstood without showing any sign of distress the sudden loads thrown on it when severe faults have developed on the large overhead and underground network to which it is coupled.

The first step in the process of getting rid of the step-up transformers connecting the generators to the grid network has been made. The standard pressures of transmission in Great Britain are 33, 66, and 132 kilovolts Manufacturers can now make 33-kilovolt generators, and doubtless 66-kilovolt generators will soon be made. In the meantime, however, these pressure generators can be advantageously used on 33-kilovolt circuits. Although the authors in this paper confine themselves to high-voltage generators, it is obvious that the ever-increasing size of motors, motor generators, and synchronous condensers will enable them soon to be economically designed so as to be coupled directly to the network without the use of intermediate transformers. Sir Charles Parsons and his associates are to be congratulated on having initiated a new and very promising development in electrical engineering.

The New Acoustics.[1]

RAYLEIGH'S "Theory of Sound," published more than fifty years ago, may be taken as representing the whole range of the physical acoustics of that period, and the much-enlarged second edition, published eighteen years later, gave, in conjunction with Helmholtz's "Sensations of Tone," a fairly complete view of the acoustics of a generation ago. Subsequent treatises have followed the classical methods thus established, and show little trace of the revolution which has occurred during the past decade in consequence of the influence of electrical theory and practice. These changes have been stimulated by needs arising partly out of the War, but still more out of broadcasting.

On the experimental side, much new apparatus of an electrical character has become available. The

[1] Summary of presidential address delivered to the Physical Society on Mar 22, 1929, by Dr W H Eccles F R S.

condenser microphone enables sound to be converted into its equivalent electrical current with the minimum of distortion and, in conjunction with the triode amplifier, enables vibrations to be detected and measured which, though of audio-frequency, are inaudibly weak. The triode can also be used for the production of sounds the amplitude and frequency of which are widely variable and can be maintained very constant The electric filter circuit has provided a powerful method of purifying and sifting oscillations of mixed frequencies. The conversion of sound into electrical oscillations enables the whole range of electrical methods of measurement to be used.

On the theoretical side, the technique which has been developed for the study of impedance networks has been applied to the solution of acoustical problems. For example, the squeaking of a slate pencil is analogous to electric relaxation phenomena, such as the flashing of a shunted neon lamp.

Architectural acoustics has benefited by the availability of loud, filtered monotone sounds and distortionless sound-detectors The decay of sound due to absorption in the walls of an auditorium, first studied by Sabine, has been accurately measured by electrical methods, with great advantages for the regulation of reverberation in buildings, both by architectural design and by the development of sound-proof materials.

In the realm of physiological acoustics, such interesting facts have emerged as that a change in intensity of a monotone must reach ten per cent to be noticeable. Accurate results have also been obtained for the range of pressure and amplitude within which a sound must lie to be audible, and for the masking of one sound by another of different pitch.

One practical outcome of these researches has been the development of public address apparatus, by means of which an orator can address an audience of a million persons Many problems of distortion have had to be solved in the working out of this apparently simple system, which comprises a microphone, amplifiers, and loud-speakers The intensities of the sounds to be dealt with vary in the ratio of 1 to 1500 in the case of speech and 1 to 100,000 in the case of music; and it is found that if all the harmonics of a given sound be amplified equally, the resultant sound appears to be distorted, owing, presumably, to the non-linear response of the ear.

Conceptions and nomenclature developed in connexion with electrical impedance networks have been carried over into acoustics. The 'motional impedance' of a telephone diaphragm was implicitly recognised in earlier works, but in the hands of Kennelly and Pierce, who introduced the nomenclature, Hahnemann, Hecht, Webster, and others, the representation in electrical terms of the inertia, resilience and energy dissipation in mechanical parts has yielded valuable results. Thus, it has been found that the impedance of a horn approaches pure resistivity (yielding maximum efficiency) at frequencies above a lower cut-off frequency which is very much lower for an exponential than for a conical horn. The conception of motional impedance can be applied to clarify substantially the design of complicated electro-acoustic combinations such as that which is constituted by a loud-speaker: a detailed example was given by the lecturer.

In measuring the subjective loudness of sounds, telephone engineers have introduced the conception of the 800-cycle standard mile: this corresponds to the difference in aural sensations derived from telephones at the beginning and end of a mile of standard cable at 800 ~, and roughly to a 25 per cent difference in power. It has consequently been proposed that the increase ratio $10^{0\cdot1}$ or 1·259 of power should be standardised for all frequencies, this ratio being known as a 'transmission unit.' Thus, if the power of an auditory stimulus were increased 1000 times, the sensation would increase by 30 transmission units. Since pitch also increases according to the logarithm of frequency, the most human way of representing acoustical relations graphically is to plot transmission units against the logarithm of the frequency.

The address concluded with a suggestion that the new acoustics should find a place in college courses and examination syllabuses. C. W. H.

Natural Hybrids in Plants.

SINCE Darwin directed attention to the problem of the evolution of a species, there has been considerable interest in the extent to which the individuals of such a species form fertile offspring when crossed with other organisms not included in the species Obviously, if such attempts at hybridisation were ineffective under natural conditions or yielded infertile offspring, then the maintenance of the species as a distinct race was readily intelligible, however difficult it might be to understand how varieties crossing readily with one another had in course of time devolved into distinct species which had lost the power of interbreeding

During the recent discussion upon natural hybrids of plants at the Linnean Society of London on Feb 28, the president, Sir Sidney Harmer, and Mr. M. A. C Hinton, pointed out that amongst the wild mammals, naturally occurring hybrids are almost unrecorded It will be remembered that Huxley always regarded this property of fertility within its ranks and failure to breed outside them as one of the most characteristic features of the natural species, and therefore as the outstanding feature which distinguished it from a race of cultivated animals or plants produced by artificial selection. The latter is often as distinct in structure and form as many a good natural species, but continued to breed freely with other races within the same domesticated species.

Darwin in the "Origin" clearly recognised that natural affinity, as expressed in a natural classification, included the sum of all characteristics of the organisms, including those connected with fertilisation mechanisms, so that natural affinity was usually an index to capacity to interbreed As a general rule, therefore, varieties crossed more freely than species, and species than genera, yet the diverse factors associated with reproduction in the organism varied from type to type so that some varieties failed to interbreed, whilst in other cases genera might yield intergeneric hybrids and species would only ripen seed if crossed by foreign pollen

Since the days when the significance of these natural hybrids to the study of evolution were grasped, our knowledge of their occurrence has considerably advanced, as was well illustrated by the discussion at the Linnean Society. Dr. A. W. Hill dealt with the New Zealand flora, in which some 290 groups of wild hybrids have now been noted, belonging to 42 families and 92 genera. In some genera, as *Phormium*, which includes the New Zealand flax plant, these plants open up questions of great economic importance.

A remarkable series of *Gaultheria* hybrids were exhibited by Dr. Hill, which showed a gradual transition from *G. oppositifolia* to *G. antipoda* and *G. rupestris*, and thence to *G perplexa*, also series between *G. perplexa* and *antipoda* and *rupestris* and

antipoda. The species *oppositifolia* and *rupestris* have a dry capsular fruit without fleshy calyx segments, in *antipoda* the calyx becomes thick and fleshy as the fruit ripens, whilst in *perplexa*, in addition, the fruit is a fleshy berry. Most of these hybrid Gaultherias produce viable seeds. Messrs E M Marsden-Jones and W. B. Turrill described genetical experiments and field observations on certain British genera They conclude that the polymorphism of such a genus as *Centaurea* owes much to hybridisation, which is thus one, but only one, of the factors in organic evolution

Prof. C E. Moss described some of the natural hybrids of *Clematis*, *Anemone*, and *Gerbera* occurring in the Transvaal. The study of such natural hybrids leads Prof. Moss to the conclusion that bigeneric hybrids occur in Nature and may be fertile Similarly, fertile hybrids occur between well-defined species Hybrids of either of these classes are not common, they are often striking plants and are easily detected. On the other hand, between closely allied species, fertile hybrids may readily occur in abundance and may give rise to that polymorphism in some groups of species which is so perplexing to the systematist. Prof. Moss stated that he had met no case of the occurrence of natural hybrids in the field, which led him to think that natural hybrids gave rise to species

Dr. Lloyd Praeger pointed out that, of some fifty species of *Sempervivum* in the Canary Islands, some thirty-five were known to hybridise; amongst the hybrid offspring barrenness is very general. Dr O. Stapf, speaking from the point of view of a systematist, agreed that hybrids are abundant in many plant families in Nature, and thought that the isolation of a hybrid progeny may lead to the appearance of a new species.

Dr. J. P. Lotsy is the champion of the theory that hybridisation is the main instrument of species evolution, and Dr. C. L. Huskins pointed out that this theory includes the possibility of 'hybridisation' within a single nucleus. Obviously the problem will in the future be taken further as this wealth of natural hybrid material is submitted to cytological examination; the data as yet available from such cytological work were utilised by Dr E J Collins in his contribution to the discussion.

University and Educational Intelligence.

APPLICATIONS are invited by the London County Council for two Robert Blair fellowships, each of the annual value of £450, tenable for one year. The fellowships are for advanced study or research in applied science and technology, and are tenable in the Dominions, the United States or other foreign countries. Further particulars and application forms (T.3)/300 may be obtained from the Education Officer (T.3), The County Hall, S.E 1. The completed forms must be returned by June 18.

THE St. Andrews Committee for the Training of Teachers is organising a summer school, to be held at the United College, St. Andrews, on July 8–26. Courses of lectures on modern advances in physical science, by Prof. H. Stanley Allen, on the teaching of physics and chemistry, by Messrs. J. W. Bispham and R. H. Dickinson, and on rural science, by Mr. M. R. Gillanders, are included in the programme. Particulars can be obtained from the Director of Studies, Training College, Park Place, Dundee; applications to attend must be sent in not later than May 1.

THE recently published Annual Report of the Carnegie Trust for the Universities of Scotland is of more than ordinary interest, including, as it does, statements showing the working during the five years 1923–28 of the Trust's various schemes for encouraging the pursuit of scientific research. Under the scheme of postgraduate study and research, which has been in operation for twenty-five years, 478 awards were made in the quinquennium at a cost of £51,047. Closely associated with this scheme is the provision made by the Trust since 1923–24 for 'teaching fellowships' for university lecturers and assistants, who hold them subject to the condition of devoting not less than half their time to research. Forty-one such fellows have been at work at a cost to the Trust of £20,023. Detailed reports, classified under subject headings, of the work done under these schemes and of researches, subsidised by the Trust, in the laboratory of the Royal College of Physicians, cover about eighty pages. Of more general interest are the reviews by the Trust's expert advisers Reviewing the work done in (1) physics and chemistry and (2) biology and medicine, Profs. Arthur Smithells and J. T. Wilson both comment on the increasing demand for scientific assistance in industrial concerns. There is a greater demand for trained chemists than has ever been known in Great Britain, and the lure of industrial appointments has led in many instances to the curtailment of the period of tenure of fellowships and scholarships. The Trust's research schemes function, says Prof. Wilson, as a sort of unofficial Scottish staff college for research, from which are recruited personnel not only for university staffs, but also for staffs of other public laboratories and institutions. They cost the Trust £82,700 during the quinquennium. Its grants to universities and extra-mural institutions for 1925–30 amount to £231,225, assistance to Scottish students in the payment of university class fees in the one year 1927–28 amounted to £57,772.

THE University of Leeds gives, in its report for 1927–28, an account of important additions, costing upwards of £150,000, to its buildings. Increased accommodation was thus provided for the medical, dental, mining, and textile departments and for the residence of men and women students. Plans were also approved for new buildings for the physics and chemistry departments. Statistical tables appended to the report show that during the five years 1923–28 the number of full-time day-students has continuously declined from 1475 to 1296. It is, however, still nearly twice the number (663) in 1913–14. The decrease in 1927–28, compared with the preceding year, was chiefly among men students in the faculties of technology and medicine, and women students in the faculty of arts. Facilities for research were substantially increased during the year, notably by (1) the acquisition of an estate suitable for the pursuit of cancer research, and including a convenient residence for the professor of experimental pathology; (2) a grant by the Clothworkers' Company of £3000 a year for four years, enabling the University to appoint a lecturer in textile physics with a research assistant and to award eight fellowships for investigators in the textile industries and dyeing departments; (3) the recognition of researches conducted in the laboratories at Torridon of the British Research Association for the Woollen and Worsted Industries as qualifying for the University's research degrees. It has been decided to publish annually, in a separate pamphlet, short summaries of unpublished research work and references to published work accepted for higher degrees, and to include in the pamphlet the list, hitherto published as an appendix to the annual general report, of works, original papers, etc., by members of the University. Among gifts to the University during the year was one by Messrs. Briggs, Son and Co., of a scholarship of £150 a year for five years, tenable in the Mining Department.

Calendar of Patent Records.

April 14, 1720 —The 'stoving' process of seasoning timber for shipbuilding—in which the timber is heated in wet sand—was the invention of John Cumberland, whose patent is dated April 14, 1720 The process, which was reported by the Admiralty to be much superior to the old method of charring that it displaced, was used in the Royal dockyards for some years, an allowance of £200 a year being guaranteed to the inventor. An application for a prolongation of the grant was dismissed.

April 17, 1882 —The 'telpher' system of transportation—in which goods are carried by electrically operated and automatically controlled trolleys travelling on a mono-rail—was the invention of Prof. Fleeming Jenkin, his patent being dated April 17, 1882 The first commercial installation in England was opened in 1885 for carrying clay from the pits at Glynde in Sussex to the railway

April 18, 1707 —On April 18, 1707, there was granted to the first Abraham Darby a patent for his invention of 'casting iron bellied potts and other iron bellied ware in sand only without loam or clay," which greatly increased the use of iron for founding purposes Previous to this invention, such articles were only made in the more costly brass, iron castings being confined to the production of simpler articles such as fire-backs and grave-slabs Abraham Darby's name is an honoured one in the history of the iron industry, for it was he who, about 1710, first discovered and put into practice a satisfactory process for the smelting of iron with coke

April 18, 1818 —The omnibus dates from the French patent granted to De Berckem of Paris on April 18, 1818, for what he called a 'Parisienne,' carrying eighteen persons A previous attempt—with which Blaise Pascal was associated—had been made to run public vehicles of this kind in Paris, but it was not successful and was soon abandoned

April 18, 1838 —William Barnett's patent, dated April 18, 1838, is an important milestone in the history of the gas engine, for it was in this that the advantages of compressing the combustible mixture before igniting it were first pointed out In Barnett's engine the air and gas were compressed separately and were mixed in the cylinder at the beginning of each stroke A special ignition cock, which remained long in use, was also a feature of the invention

April 18, 1885 —One of the early suggestions for utilising the principle of the gyroscope to replace that of the magnetic needle in the mariner's compass was the invention of two Dutchmen, Gerardus van den Bos and Barend Janse, whose German patent was applied for on April 18, 1885.

April 19, 1758.—The achromatic telescope of John Dollond was patented on April 19, 1758 No action seems to have been taken by the Privy Council on a petition signed by most of the instrument-makers of London, alleging that object-glasses in accordance with Dollond's patent had been made and publicly sold before the date of the grant and praying for the revocation of the patent, and the patent was afterwards upheld in the Courts in an action for infringement But there seems to be little doubt that Chester Moor Hall was the first inventor

On the same day, April 19, 1758, there was granted to Jedediah Strutt a patent for the rib-stitch hosiery frame, which was the first important modification of Lee's stocking frame. Strutt invented the rib-stitch machine for his hosier brother-in-law, William Woollatt, and the two started what became very successful works at Derby and Nottingham

Societies and Academies.

LONDON

Mineralogical Society, Mar. 19 —**A. W. Groves** and **A. E Mourant** Inclusions in the apatities of some igneous rocks Apatite crystals with dark cores of inclusions have been observed among the heavy minerals of some English sedimentary rocks, but there are few records of such apatites in igneous rocks. The authors record several such occurrences in granites and in volcanic rocks from Normandy, Jersey, and Brittany Five different types are distinguished in the granite of northern Brittany alone In one type with a definitely pleochroic core the inclusions appear to consist of biotite or chlorite, but in other types it has not been possible to determine their nature —**L. A Narayana Iyer** Calc-gneisses and cordierite-sillimanite-gneisses of Coimbatore, Madras Pres, and similar occurrences in India. The paper dealt with a suite of crystalline gneisses in the ancient Archæan complex of India of Dharwar age (Huronian), consisting of the above two facies, which are in close association Similar suites of rock occur in different parts of India, forming a definite stratigraphic horizon The author considers their formation as due to thermal or 'infra-plutonic' metamorphism followed or accompanied by regional or dynamo-thermal metamorphism of pelitic schists and calcareous sediments —**F A Bannister** A relation between the density and refractive index of silicate glasses with application to the determination of imitation gem-stones. The study of simple glass families leads to a relation between the refractive index and density which can be applied in a modified form to the determination of imitation gem-stones $(n-N)/(d-D)$, where N and D are the refractive index and density of silica glass, is plotted against n by a simple graphical method, whereupon the various imitations separate into groups, the members comprising any one group are chemically similar Doubtful cases can be solved by measuring in addition the relative dispersion —**H. E Buckley**: The crystallisation of potash-alum The author described the results of experiments on the differences of crystal habit obtained under varying conditions of cooling and evaporation, and in the presence of various substances in solution such as strong acids, $AlCl_3$, FCl_3, amyl alcohol, Bismarck Brown, etc.

PARIS.

Academy of Sciences, Mar. 4.—**A. Deslandres**: Simple relations between the most intense and highest radiations of the chemical elements in the photosphere of the sun In previous communications it was shown that the frequencies of the highest and most brilliant lines of the sun were multiples of a constant d_1, 1062 5 Additional data showing the importance of this constant are given.—**Charles Moureu, Charles Dufraisse**, and **Léon Enderlin** Researches on rubrene. The action of acids. The liberation of iodine from hydriodic acid by rubrene, with decolorisation of the hydrocarbon, has been studied in detail Except possibly in ether solution, there is no evidence of any hydrogenation the colourless hydrocarbon produced appears to be isomeric with rubrene —**J. Favard**: Problems of extremums relative to convex curves —**Maurice Janet** The ratio of the mean values of the squares of two differentials of consecutive order. —**Mandelbrojt** How several theorems of Taylor's series can be transformed into Dirichlet's series.—**J. Delsarte** Symmetroid nuclei —**L Ahlfors** The number of asymptotic values for an integral function of finite order.—**M. Lavrentieff**. A problem of P. Montel.—**Gr. C Moisil**: Functional groups.—**D.**

Rosenthal Assemblages connected by lateral bands tested in extension and in compression.—**Maris Bossolasco**: The ellipticity of the terrestrial equator.—**Foch** The maintenance of the vibrations of a fluid column by change in the regime of flow. From Reynolds's definition of the critical velocity an equation is derived which has been applied to the cases of vibrating flames, the chemical harmonicon, and notes emitted by certain hot-water systems.—**T. Pecsalski** and **J. Chichocki**. The thermionic emission of copper tubes filled with salts.—**J. Peltier**. The magnetic testing of the shafts of machines.—**R. Coustal** and **F. Prevet**. A new method of preparing phosphorescent zinc sulphide. Zinc (in impalpable powder) and sulphur are heated together, with or without the addition of foreign substances. The reaction is explosive and must be controlled by reducing the proportion of zinc.—**R. de Mallemann**: The theory of optical activity in a homogeneous medium.—**René Delaplace** Some chemical phenomena connected with the contraction of hydrogen in discharge tubes Discharges through tubes of Pyrex glass, not fitted with taps or ground glass connexions, produce measurable amounts of carbon monoxide and methene. These may be attributed to the dissociation of the glass under the influence of radiations emitted by the tube.—**Raymond Delaby** and **Pierre Dubois**: The preparation of allyl alcohol The method described permits of a yield of 435 grams of allyl alcohol per kilogram of glycerol.—**Mlles. Jeanne Lévy** and **Frajda Gombinska** The dehydration of some symmetrically substituted *a*-glycols and the isomerisation of the corresponding ethylene oxides The influence of the relative affinitary capacities of the cyclic and acyclic radicals.—**A Seyewetz** and **J. Blanc**: The fluorescence of colouring matters in Wood's light. The principal dyes of each class have been submitted to Wood's light in powder, in solution, and on fibres, in order to see whether they would present any fluorescence sufficiently characteristic for use in analysis. Preliminary results are given.—**Assar Hadding** and **René van Rubel**: The structure of the crystalline uraninite of Katanga (Belgian Congo) The X-ray method of P Debye has been applied to Katanga uraninite Its crystalline network is that of a face-centred tube.—**P Fallot** The date of the latest orogenic phenomena in the sub-Betic and Betic zones at the height of Caravaca.—**Jean Lacoste** The extension of the Cretaceous in the southern region of the western Rif.—**Edouard Roch** New observations on the Stephanian of western Morocco.—**Ch. Maurain** and **E. Salles** Atmospheric ionisation.—**Albert Nodon**: Researches on electromagnetic perturbations, seismic and solar The results obtained at the Santiago Observatory (Chile) confirm work previously published by the author, and show that close relations exist between electromagnetic, seismic, telluric, atmospheric, and solar phenomena. It is possible from the indications of the magnetograph to predict earthquakes some hours in advance.—**C. I. Popesco**. The influence of grafting on the development of some Papilionaceæ.—**Mme L. Randoin** and **Mlle. A. Michaux**: The comparative variations of the proportion of water in the blood and of the globular resistance in the normal guinea-pig and in the guinea-pig submitted to a regime deprived of the antiscorbutic vitamin.—**Mme. M. L Verrier** The biology and peculiarities of the respiratory apparatus of an isopod from the Sahara, *Hemilepistus Reaumuri*.—**J. Magrou, Mme. M. Magrou**, and **Mlle. F. Choucroun** The action at a distance of *Bacterium tumefaciens* on the development of the egg of the sea-urchin. New experiments.—**E. Roubaud**: Autogenous cycle of waiting and hidden active winter generations in the common mosquito. *Culex pipiens* can have two different biological methods of adaptation to the winter. In one, well known, the females hibernate at low temperatures, in the other, described in the present communication, both sexes survive if the temperature is maintained above 20° C in presence of water. Reproduction is continuous during the winter without food being taken.—**Marcel Labbé, F. Nepveux**, and **Hejda**. The ammonia of human blood in normal and pathological conditions. In cases of jaundice, cirrhosis of the liver, and diabetes, the proportion of ammonia in the blood varies very slightly from the normal: the amount is increased to a marked extent in pulmonary tuberculosis.—**H. Bierry**: Biochemical researches on the specificity and transformations of the proteids of the blood plasma.—**L. Hugounenq** and **E. Couture**. The photochemical action of sterols of various origins.—**A. Dorier**: *Gordius* as a parasite of myriapods.—**A.** and **R Sartory, Marcel** and **Jacques Meyer** Contribution to the study of the mycetones A new case of actinomycosis with yellow pustules

Rome

Royal National Academy of the Lincei, Dec. 16.—**T. Levi-Civita** Addition to the note on the motion of a body of variable mass.—**Gino Fano**: Congruences Ω_0 of rational curves, and Cremonian transformations inherent in a linear complex.—**A Russo**: Nuclear divisions in *Cryptochilum echini* Mps In this organism the processes of nuclear division are dependent on the category of the individuals to which the nuclei belong, since the nuclei of one category (A) divide by mitosis, and those of another (B) by amitosis. These two categories being distinguished by different quantities of nuclear substance, with which correspond particular activities of the whole individual, it appears that the special division of the nucleus is determined by internal factors which regulate the process.—**L. A Herrera** Further investigations on the imitation of organic forms with albumin. Structures obtained by means of egg-albumin and closely resembling *Croococcus, Botrydina vulgaris, Desmidium Grevilli, Bulbochæte, Vaucheria.* and *Nitella flexilis*, are illustrated.—**U. Cassina**: The conception of limits A short, elementary account is given of the results of the author's historical and critical investigation into the conceptions expressed by the term 'limit'.—**L. Fantappié**. Functional operators and the calculus of infinite matrices in the theory of quanta (1).—**M. Picone** Demonstration of a theorem of analysis, of which use is made in plane physics.—**G Supino** Certain limitations valid for derivates of a harmonic function.—**L. Toscano**: Reciprocal matrix equations.—**G. Vranceanu**. Second fundamental quadratic form of an anolonomous variety and its applications.—**V. Glivenko**. The law of high numbers in functional spaces.—**A. de Mira Fernandes**: Isoclinic transports and associated directions.—**F. Lamberti** A third cardinal equation in the dynamics of material systems.—**E. Gugino**. The extension to continuous motion of the Lagrange-Bertrand theorem relating to impulsive motion.—**G. Silva**: The definition of normal gravity.—**E. Benedetti** Experiments on the amplification and detection of bio-electric currents by means of thermionic valves (2) The photographic registration of the curves of the amplified currents. Use is made of a ray reflected by a mirror set in motion by an electrodynamic complex similar to those used to move the membranes of 'loud speakers'.—**Clara Forti**. The action of vapours of ethyl and methyl alcohols, ethyl ether, and chloroform, and of lighting gas on leucocytes isolated from the organism. The vapour evolved by minimum quantities (0 1-0·5 c c) of ethyl or methyl alcohol, ether or chloroform suffices to paralyse

the amœboid activity of the leucocytes of toad-blood within a few minutes The action of illuminating gas is slow and results first in an increase in the vivacity of movement of the leucocytes, but later to a gradual retardation of the motion, which is completely arrested after exposure to the gas for eight or nine hours These effects may be either transient or permanent, according to the duration of action of the reagent.—**G. Galatà** Investigations on the circulatory effects of increases in the atrial pressure.—**R Margaria** and **E. Sapegno** · Blood mass, red corpuscles, and hæmoglobin, in acclimatised individuals, in the mountains and on the plain. The observations described were made on ten individuals, first, in August 1927 at Col d'Olen (altitude 2901 metres), and, secondly, in the autumn and winter of 1927–28 at Turin, the temperatures in both cases being 10°-13°. At Col d'Olen, increases in the number of red corpuscles and in the hæmoglobin-content of the blood were invariably found The extents of these increases varied markedly in different individuals, the mean values being 12 8 per cent for the corpuscles and about 4 per cent. for the hæmoglobin. There is, therefore, a diminution in the hæmoglobin-content of the red corpuscles, which may be the expression of the immission into circulation of young red corpuscles less rich in hæmoglobin—a phenomenon perfectly analogous to that observed after blood-letting As regards the mass of the blood, determined by Haldane and Smith's method, the variations found amounted only to about 5 per cent, which corresponds with the limit of error for a single experiment; there is a mean increase of 1 8 per cent, which indicates that there is a slight increase in the mass of the blood following a sojourn of 15-25 days in the mountains, this being possibly due to the improved hygienic conditions —**R Grandori** Embryological studies on polyvoltine races of the mulberry *Bombyx*.

VIENNA

Academy of Sciences, Jan 10 —**R. Holzapfel** Results of radiation and polarisation experiments on the Hochobir in the summer of 1927 at an altitude of 2040 metres —**E. Philippi** and **E Galter** The action of ammonia and amines on the esters of unsaturated acids —**E Philippi** Memoranda for the preparation of some aliphatic unsaturated acids and esters —**F. Hernler** The three isomeric tolyl-1-dimethyl-3, 5-triazole-1,2,4 and some of their salts —**G Grekowitz** A meningitis producer from the Pasteurella group In three cases of middle ear discharge a germ was isolated, a small coccus-like bacterium easily stained with the usual aniline dyes, but not with Gram A faint smell is characteristic of the colonies. Gelatine was not liquefied Milk sugar and mannite were neither acidified nor fermented.—**F. Werner** Scientific results of a journey of exploration to Western Algeria and Morocco. Snakes, lizards, and scorpions are recorded —**E. Bersa**: The culture and nutrition physiology of the genus *Pilobolus* Easily cultivated on horse-dung decoction agar. Of nitrogen sources leucine and peptone, of carbon sources xylan, gum arabic, galactose, starch do best A wheat straw extract with peptone and agar proved a good culture medium, also Liebig-extract-agar-peptone —**K. Menger** On the sum of regular curves —**K. Przibram** Coloration of rock-salt by radium rays and re-crystallisation. Apparently rock-salt on compression undergoes re-crystallisation, the more rapid when pressure is greater. After such re-crystallisation the blue colour and the capacity of turning blue have vanished —**O. Watzl**, **K. Swoboda**, and **R. Singer** Report on a botanical and geological expedition in the Caucasus The Caucasian Alpine Society supplied intelligence. The Dongusorun glacier pass (3200 metres) was difficult. The Chodschal mountain group (3309 metres) was examined Valleys choked with thick primitive forest were difficult to penetrate, the few paths being mostly on slopes above the tree limit. Collections were made of Rhododendron and other shrubs and of the very rich fungus flora.

Official Publications Received.

BRITISH

The Scientific Proceedings of the Royal Dublin Society Vol 19 (N S), No 18 The Photo-Electric Measurement of the Illumination in Buildings By Dr W R G Atkins and Dr H H Poole Pp 173-188 (Dublin Hodges, Figgis and Co , London Williams and Norgate, Ltd) 1s

Transactions of the Royal Society of Edinburgh Vol 56, Part 1, No 9, On the Feeding Mechanism of the Syncarid Crustacea By Dr H. Graham Cannon and Miss S M Manton Pp 175-189 2s Vol 56, Part 1, No 10 A Human Blastocyst *in situ* By Dr C Witherington Stump Pp 191-202+10 plates 5s (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd)

Education in Kent during the Five Years 1923–1928 Pp xi+314 (Maidstone Kent Education Committee)

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 67, No 387, March 1929 Pp 317-436+xxxvi (London E and F N Spon, Ltd) 10s 6*d*

Report of the Medical Research Council for the Year 1927–1928 (Cmd. 3276) Pp 165 (London H M Stationery Office) 3*s* net

Dove Marine Laboratory, Cullercoats, Northumberland Report for the Year ending June 30th, 1928 Edited by Prof Alexander Meek (New Series 17) Pp 50 (Cullercoats) 5s

Department of Scientific and Industrial Research Gas Cylinders Research Committee Ordinary Commercial Cylinders for the "Permanent" Gases Summary of Recommendations (revised) Pp iii+7 (London. H M Stationery Office) 4*d* net

The New Education Fellowship (English Section) Annual Report, 1928. Pp 19 (London)

The Federation of Lancashire and Cheshire Museums First Annual Report, 1928, adopted at the Annual General Meeting, January 30th, 1929 Pp 11 (Liverpool)

Annual Report of the Calcutta School of Tropical Medicine, Institute of Hygiene and the Carmichael Hospital for Tropical Diseases, 1928 Pp. 103+3 plates (Calcutta Bengal Government Press)

Journal and Proceedings of the Asiatic Society of Bengal New Series, Vol 23, 1927, No 3 Pp 249-560+plates 6-13 (Calcutta)

The Education Question and the General Election being the Annual Report of the National Education Association presented to the Annual Meeting on Tuesday, January 22nd, 1929 Pp 12 (London) 3*d*

The British Mycological Society Transactions Edited by Carleton Rea and J Ramsbottom Vol 14, Parts 1 and 2, March 11 Pp. 178 (Cambridge At the University Press) 15s

The Proceedings of the Physical Society Vol 41, Part 2, No 227, February 15 Pp viii+113-179 (London) 7*s* net

Department of Scientific and Industrial Research Building Science Abstracts Compiled by the Building Research Station and published in conjunction with the Institute of Builders Vol 2, (New Series), No 1, January Abstracts Nos 1-200 Pp ii+54 (London H M Stationery Office) 9*d*

Transactions and Proceedings of the Perthshire Society of Natural Science Vol 8, Part 5, 1927–28 Pp 235-264+li-lx+plates 35-46 (Perth) 3*s* 6*d* , to Members, 2s 6*d*

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1189 (Ae 351) Notes on Longitudinal Stability at Stalling in Gliding Flight By S B Gates (T 2647) Pp 7+5 plates 6*d* net. No 1191 (Ae 353) Full Scale Tests of a Standard Bristol Fighter Aeroplane fitted with "Pilot Planes" at the Wing Tips By W G Jennings (T 2663) Pp. 5+3 plates 6*d* net (London H M Stationery Office)

St Andrews Provincial Committee for the Training of Teachers Summer School, St Andrews, July 8th to July 26th, 1929 Pp 20 (St. Andrews)

FOREIGN

Transactions of the San Diego Society of Natural History Vol 5, No 14 Discocyclina in California By Hubert G Schenck Pp 211-240+plates 27-30 Vol 5, No 15 A new Pocket Gopher and a new Antelope Ground Squirrel from Lower California, Mexico By Laurence M Huey. Pp 241-244 (San Diego, Calif)

Bulletin of the American Museum of Natural History Vol 58, Art 5 Functional Adaptations of the Pelvis in Marsupials By Herbert Oliver Elftman Pp 189-232+plates 9-14 (New York City)

Veroffentlichungen des Instituts fur Meereskunde an der Universitat Berlin Neue Folge, A Geographisch-naturwissenschaftliche Reihe Heft 19 · Stabile Lagerung ozeanischer Wasserkorper und dazugehorige Stromsysteme Von A Defant Pp 33 Heft 20 Schichtung und Tiefenzirkulation des pazifischen Ozeans auf Grund zweier Langsschnitte Von Georg Wüst Pp 64+4 Tafeln (Berlin E S Mittler und Sohn)

Ministry of Agriculture, Egypt The Agricultural Journal of Egypt New Annual Series, 1924 and 1925 Pp ii+166 (Cairo Government Publications Office) 5 P T

Annual Report of the Meteorological Observatory of the Government-General of Tyôsen for the Year 1926 Pp v+154 (Zinsen)

R Osservatorio Astrofisico di Catania Annuario 1929 Pp iii+39 (Catania)

Japanese Journal of Engineering Abstracts Vol 6 Pp x+89 (Tokyo National Research Council of Japan)

Proceedings of the American Philosophical Society held at Philadelphia for Promoting Useful Knowledge Vol 67, No 4, 1928. Pp xx+319-384 (Philadelphia, Pa)

Forty-first Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1919-1924 With Accompanying Papers Coiled Basketry in British Columbia and surrounding Region, by H K Haeberlin, James A Teit and Helen H Roberts, under the direction of Franz Boas, Two Prehistoric Villages in Middle Tennessee, by William Edward Meyer Pp ix + 626 + 138 plates (Washington, D C Government Printing Office) 2 50 dollars

Smithsonian Institution United States National Museum Bulletin 145 A Revision of the North American Species of Buprestid Beetles belonging to the Genus Agrilus By W S Fisher Pp v+345+11 plates 65 cents Report on the Progress and Condition of the United States National Museum for the Year ended June 30, 1928 Pp ix+216 25 cents (Washington, D C Government Printing Office)

U S Department of the Interior Forty-ninth Annual Report of the Director of the Geological Survey to the Secretary of the Interior, 1928 Pp ii+77 (Washington, D C Government Printing Office)

Department of the Interior U S Geological Survey Water Supply Paper 586 Surface Water Supply of the United States, 1924 Part 6 Missouri River Basin Pp viii+343 50 cents Water-Supply Paper 588 Surface Water Supply of the United States, 1924 Part 8 Western Gulf of Mexico Basins Pp vi+229 25 cents (Washington, D C Government Printing Office)

Cornell University Agricultural Experiment Station Memoir 116 Rural Population of New York, 1855 to 1925 By Bruce L Melvin Pp 121 Memoir 117 Chromosome Numbers in Zea Mays L By L F Randolph Pp 44 (Ithaca, N Y)

Department of Commerce Bureau of Standards Bureau of Standards Journal of Research, Vol 2, No 1, January Fire Resistance of Hollow Load-bearing Wall Tile By S H Ingberg and H D Foster Pp 834+42 plates (Washington, D C Government Printing Office)

Smithsonian Miscellaneous Collections Vol 81, No 7 Recent Archaeological Developments in the Vicinity of El Paso, Texas By Frank H H Roberts, Jr (Publication 3000) Pp 14+5 plates (Washington, D C Smithsonian Institution)

National Research Council Organization and Members, 1928-1929 Pp 63 (Washington, D C National Academy of Sciences)

Reprint and Circular Series of the National Research Council No 85 Report of the Committee on Sedimentation, 1927-1928 Pp 83 1 dollar No 86 Doctorates conferred in the Sciences by American Universities, 1927-1928 Compiled by Callie Hull and Clarence J West Pp 38 50 cents (Washington, D C National Academy of Sciences)

Bulletin of the National Research Council No 65 Bibliography of Bibliographies on Psychology, 1900-1927 Compiled by C M Louttit Pp. 108 1 50 dollars No 66 Funds available in the United States for the Support and Encouragement of Research in Science and its Technologies Compiled by Callie Hull and Clarence J West Second edition Pp 90 1 dollar (Washington, D C National Academy of Sciences)

Catalogues.

A Catalogue of Important and Rare Books on Zoology, Geology and Palæontology (No 424) Pp 128 (London Bernard Quaritch, Ltd)

Catalogue No 167 Astronomy, Chemistry, Entomology, Fishes, General Natural History, Geology, Mathematics, Ornithology, Physics, Sundials, etc Pp 48 (London Dulau and Co , Ltd)

Surveying, Drawing and Nautical Instruments (Catalogue S M Section) Pp 121. (London J H. Steward, Ltd)

Diary of Societies.

FRIDAY, April 12

Royal Society of Arts (Indian Section), at 4 30 —A T Cooper Recent Electrical Developments in India

Royal Astronomical Society, at 5 —L Rosenhead The Annual Variation of Latitude —E A Kreiken On the Dwarf Nature of the Spectroscopic Binaries —H Horrocks. The Longitude of the Royal Observatory, Cape of Good Hope, from Wireless Signals, Oct -Nov 1926 —S A Mitchell Atlas Stellarum Variabilium, Series VII

Malacological Society (at University College), at 6

Society of Chemical Industry (Manchester Section) (Annual General Meeting) (at Engineers' Club, Manchester), at 7 —T R Woolaston Suggestions in Steam Raising

Institution of Mechanical Engineers (Informal Meeting), at 7 —F E F Durham Pumping Plant

Royal Photographic Society of Great Britain, at 7 —H W Bennett Sulphide Toning

Junior Institution of Engineers, at 7 30 —B V Lambert The Collection of Fine Dust arising from Metallurgical and other Processes

Geologists' Association (at University College), at 7 30 —E J Wayland The Later Geological History of the Equatorial Lakes in Uganda

Oil and Colour Chemists' Association (Manchester Section) (at Milton Hall, Manchester), at 7 30 —Annual General Meeting

Institute of Transport (at Y M C A , Newcastle-upon-Tyne), at 7 30

Society of Chemical Industry (Birmingham and Midland Section) (jointly with Chemical Engineering Group) (at Engineers' Club, Birmingham) —Dr C M Walter The Design and Operation of Gas Heated Furnaces

SATURDAY, April 13

Institution of Municipal and County Engineers (jointly with Yorkshire and North-Western Districts) (in College of Technology, Manchester), at 2 30 —W J Hadfield The Local Government Bill, with Particular Reference to the Road Clauses

MONDAY, April 15

Society for the Preservation of the Fauna of the Empire (at Zoological Society of London) (Annual General Meeting), at 4 —Earl of Onslow Presidential Address —Exhibition of Lantern Slides of the Kruger National Park, South Africa

Institution of Electrical Engineers (Informal Meeting), at 7 —M G Tweedie and others Discussion on Power Supply and Railway Electrical Signalling

Institution of Electrical Engineers (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7 —Annual General Meeting

Institution of Electrical Engineers (South Midland Centre) (at Birmingham University), at 7 —Hon Sir Charles A Parsons and J Rosen Direct Generation of Alternating Current at High Voltages

Royal Society of Arts, at 8 —Sir E Denison Ross Nomadic Movements in Asia (Cantor Lectures) (I)

Royal Geographical Society (at Æolian Hall), at 8 30 —Dr V Stefansson Some Problems of Arctic Travel After a Crash

TUESDAY, April 16

Royal Photographic Society of Great Britain (Colour Group), at 7 —F J Tritton Colour Snapshots

Illuminating Engineering Society —Dr J F Crowley The Use of Intermittent Light for Revealing Moving Machinery

WEDNESDAY, April 17

Royal Meteorological Society, at 5 —The late W H Dines and L H G Dines Monthly Mean Values of Radiation from Various Parts of the Sky at Benson, Oxfordshire —L H G Dines An Analysis of the Changes of Temperature with Height in the Stratosphere over the British Isles —H A Hunt A Basis for Seasonal Forecasting in Australia

Institution of Civil Engineers (Informal Meeting), at 6 —E T Painton Problems involved in the Design of Overhead Transmission-Lines

Institute of Metals (Swansea Local Section) (at Thomas' Cafe, Swansea), at 7 —Annual General Meeting

Institution of Electrical Engineers (Tees Side Sub Centre) (at Cleveland Technical Institute, Middlesbrough), at 7 —Annual General Meeting

Institution of Electrical Engineers (Sheffield Sub Centre) (at Royal Victoria Hotel, Sheffield), at 7 30 —F H Rosencrants Practice and Progress in Combustion of Coal as applied to Steam Generation

Royal Society of Arts, at 8 —F E Lamplough Vita Glass

Folk-Lore Society (at University College), at 8 —Miss Beatrice Blackwood Folk-Tales of the Chippewa Indians

Royal Microscopical Society, at 8 —Prof E Ghosh Two New Suctoria from Sewer Water —Dr P L Li, Dr H S D Garven, and Dr R H Mole The Microscopic Anatomy of the Vascular System of the Dog's Spleen —Dr D S Spence A Method of Finding the Refractive Index of a Drop of Mounting Medium

Society of Glass Technology (Annual General Meeting and Ordinary Meeting) (at Sheffield) —W Butterworth, senr The History of Glass Cutting (Lecture)

THURSDAY, April 18

Linnean Society of London, at 5 —Dr G C Druce The Botany of Cyprus —Dr G S Carter and L C Beadle The Fauna of the Swamps of the Paraguayan Chaco in Relation to its Environment II Respiratory Adaptations in the Fishes

Institution of Mining and Metallurgy (at Geological Society), at 5 30

Institution of Electrical Engineers, at 6 —R A Chattock The Modern Use of Pulverised Fuel in Power Stations

Royal Aeronautical Society (at Royal Society of Arts), at 6 30 —Col. V C Richmond R 101

Institution of Automobile Engineers (Guildford Centre) (at Technical Institute, Guildford), at 7 —H W Pitt Central Lubrication of Chassis Bearings

Institution of Electrical Engineers (Irish Centre—Dublin) (at Trinity College, Dublin), at 7 45 —J D Ferguson Electric Time Signalling

British Institute of Radiology, at 8 30 —R S Paterson The Less Common Diverticula of the Upper Alimentary Tract —J V Sparks The Difficulties of Comparative Radiography of the Chest

FRIDAY, April 19

Physical Society (at Imperial College of Science), at 5 —Presentation of the Guthrie Medal to Dr C E Guillaume —Prof W R Bridgman The Properties of the Elements under High Pressures (Guthrie Lecture)

British Institute of Radiology (Medical), at 5 —Informal Discussion on Bone-Diseases (especially Multiple Myeloma)

Institution of Mechanical Engineers, at 6 —W Reavell The Standardisation of Keys and Keyways.

Institution of Electrical Engineers (London Students' Section) (Annual General Meeting), at 6 15 —V E Connor The Manufacturing and Testing of Submarine Cables

Royal Photographic Society of Great Britain, at 7 —B Chambers and F W Sharp Carbon and Carbro

Society of Dyers and Colourists (Glasgow Section) (at 7 Gordon Street, Glasgow), at 7 15 —Annual General Meeting

Junior Institution of Engineers, at 7 30 —Lt -Col J T C Moore-Brabazon Early Aviation (Lecture)

Royal Society of Medicine (Electro-Therapeutics Section), at 8 30 —Dr S G Scott Myeloma—Differential Diagnosis —Dr J D White Bone Lesions in Tropical Diseases

Royal Institution of Great Britain, at 9 —Prof Owen T Jones History of the Grand Canyon, Yellowstone National Park

Society of Dyers and Colourists (Manchester Section) (at Manchester) —Annual General Meeting

SATURDAY, April 20.

Institution of Municipal and County Engineers (Southern District) (at Council House, Bristol), at 10 30 a m.—H F. Proctor Description of the New Power Station, Portishead

North of England Institute of Mining and Mechanical Engineers (Newcastle-upon-Tyne), at 2 30

Mining Institute of Scotland (at Royal Technical College, Glasgow).—Annual Meeting

SATURDAY, APRIL 20, 1929.

CONTENTS.

Editorial and Publishing Offices :
MACMILLAN & CO., LTD.,
ST MARTIN'S STREET, LONDON, W.C.2.

Lord Haldane in Science and Education.

THE autobiography of Lord Haldane recently published throws a flood of light on several questions of scientific and educational interest. Mr Sidney Webb once expressed the view that men of science who had entered the field of politics had not as a rule distinguished themselves in Parliament, a judgment which, with commendable impartiality, he extended to historians and economists This view was challenged at the time Playfair and Lubbock, it was suggested, had rendered valuable services as members of Parliament, and Huxley as a member of the first London School Board Ought we not to regard these instances as exceptions proving the rule ? To the man of science, groping with his taper along the rugged pathway towards truth, the eclectic arts, the rhetorical triumphs—and at times the overweening confidence—of the politicians make no strong appeal

Whatever view may be taken on this question, it will be agreed that politicians who concern themselves with the promotion of science and education are fulfilling a useful rôle in our national economy. With increasing specialisation and increasing demands on both public and private funds for the promotion of research, science needs sympathetic interpreters, missionaries—propagandists, if you will—to whose warnings and exhortations the public will listen with due respect Haldane, as a man of outstanding intellect and untiring industry, as a politician who attained the highest offices in the State, as an active participator in the gravest decision which our nation was ever called upon to make, had many of the qualifications for this essential work. That he discharged his duty with conviction and disinterestedness, the reader of the autobiography will admit. His success was partial, as he himself admits A man is a hero to his autobiographer, one would suppose ; but Haldane writes candidly in his final chapter entitled "Looking Backwards" : "I have no sense of success on any very large scale in things achieved. But I have the sense of having worked and of having found happiness in doing so." That guerdon is not withheld from the humblest of the world's workers. "One touch of Nature makes the whole world kin." Haldane's posthumous candour should induce a tolerance which was not shown by the public during his life.

Asked by Cecil Rhodes, "What have you done in your life ?" Haldane replied, "I got the London University Bill through the Houses of Parliament", on which Rhodes remarked, "That seems to be a very curious thing" The reference was to the

Bill of 1898, introduced by the Conservative Government to transform the examining university into a teaching university. Haldane was justified in his proud boast. Politically, the subject was thorny; the supporters of the old system of impartial examinations exercised powerful political influence; and the proposed scheme of re-constitution bore many of the scars of compromise. Unless some politician of strength and honesty of purpose had espoused the cause, we can well believe that the reform would never have been accomplished. The tragedy was that Haldane so soon showed a sort of Red Queen animosity towards his own offspring We must await the publication of further biographies and autobiographies before this mystery is fully explained

An interesting chapter in the history of higher education relates to the breaking-up of the old Victoria University, the federal university seated at Manchester In this important development, Haldane took an active part. Birmingham, under the influence of Joseph Chamberlain, had established the first civic university in 1900. Soon afterwards, Liverpool petitioned for a separate university "Manchester somewhat half-heartedly supported the prayer of Liverpool, but Leeds strongly opposed it, and was backed by a number of persons who were eminent in the field of higher education in those days." The hearing of the petition by a Committee of the Privy Council lasted three days Haldane was precluded from acting as counsel for Liverpool, as he had been appointed a member of the Privy Council a short time before the hearing; but he was able to plead the cause as a witness. His arguments for civic and educational personality were accepted The Committee recommended the grant of university charters to Liverpool and Manchester, and the grant of a charter to the University of Leeds followed a year later. Haldane remarks with truth: "It has always seemed to me that the decision of the Government as advised by the Privy Council in 1903 was a step of the first importance in the history of higher education." But, as he says, little notice was taken of the matter at the time by the public or by writers about English education.

The decision gave a deathblow to the federal idea in higher education in its application to our great cities and started the growth to full university stature of institutions such as the Universities of Sheffield (chartered in 1905), Bristol (1909), of which Haldane was the first Chancellor, and Reading (1926). Several university colleges are in the later stages of adolescence, including those at Nottingham, Exeter, Hull, Southampton. No one would now be found to question the wisdom of the policy advocated by Haldane in this matter.

Haldane's work in the promotion of science and technology at South Kensington is well known. The entry in the index under the author's name states summarily—"Founds the Imperial College of Science and Technology" King Edward VII. inspired this great development in a spirit of filial piety, and Haldane was brought into close personal touch with his Sovereign. Haldane's original scheme of a 'London Charlottenburg' suffered a sea-change. No doubt he was offered a surfeit of 'expert' advice. Curiously, Haldane's investigations in Germany had impressed him unfavourably with the separation existing there between the universities and the technical colleges, and he tells us he decided to press for the application of a different principle in London. "The new college was to be fashioned so as to be brought as quickly as possible into a re-constituted University of London." There must be some lapse of memory here, for, in the letter which Lord Rosebery as Chancellor of the University of London addressed to the London County Council in 1903 to explain the Charlottenburg scheme—the letter, we may safely presume, was drafted by Haldane—there was no reference to the question of re-constituting the University and this issue did not arise until some years later. Lord Rosebery, indeed, expressed the hope that it might be possible to follow up the Charlottenburg scheme "by taking further steps towards developing the University in such a fashion as to make it worthy to be the University of the metropolis of the Empire"—but the reference here is obviously to other educational rather than to constitutional developments.

Exasperating delays occurred and an unhappy controversy arose as to the relations of the Imperial College with the University, a controversy which has not yet been brought to a final conclusion It led directly to the appointment of the abortive Royal Commission on University Education in London over which Haldane presided. The autobiography does not indicate that Haldane derived much satisfaction from his attempt to re-constitute the University for a second time He is singularly reticent on the whole subject. Nevertheless, he lived long enough to see the last stages of a re-constitution of the University which, the friends of the University hope, will remove some of the defects of the earlier compromise; and he must have watched with pleasure the recent purchase of the Blooms-

bury site by the University, aided by the Rockefeller Foundation, a site he had ineffectively recommended so long ago as 1912 for the great Imperial university he wished to see established in London.

Was science able to offer any return for all this effort and goodwill? We learn with pleasure from the autobiography that Haldane benefited from a great discovery in a university laboratory. He was a sufferer from diabetes and was treated in the first attack by a rigid diet, "the only palliative known in those pre-insulin days" Banting's discovery came at a happy moment, for Haldane would not have been able to count on good health without the discovery of insulin. He arranged to have an injection in his arm every morning, and this served admirably, he tells us, taking the place of the pancreatic secretion of the 'Islands of Langerhans' Thus was prolonged a life which had rendered great services to the cause of science and had sounded the full gamut of human thought, emotion, and—may we not add, notwithstanding autobiographical diffidence—success, achievement

T LL H

A Neglected Genius

The Collected Scientific Papers of John James Waterston Edited, with a Biography, by Dr J S. Haldane Pp. lxviii + 709 + 5 plates (Edinburgh and London Oliver and Boyd, 1928) 25s. net.

IN 1892 the late Lord Rayleigh rescued from oblivion in the archives of the Royal Society a remarkable paper by John James Waterston which had been written in 1845 but had failed to obtain the approval of the Society, and had, therefore, not been printed in the *Proceedings* So completely has his work been ignored that it will probably come as a surprise to the majority that his writings (published and hitherto unpublished), which have been collected and published by Dr. J. S Haldane, extend to more than seven hundred pages.

Lord Rayleigh did ample justice to the 1845 paper on the physics of media that consist of perfectly elastic molecules in a state of motion Concerning it he wrote . "What strikes one most is the marvellous courage with which he attacked questions, some of which even now present serious difficulties Waterston was the first to introduce into the theory the conception that heat and temperature are to be measured by *vis viva*. . . . In the second section the great feature is the statement that in mixed media the mean square molecular velocity is inversely proportional to the specific weight of the molecules The proof which Waterston gave is doubtless not satisfactory, but the same may be said of that advanced by Maxwell fifteen years later" Boyle's law, Charles's law, Avogadro's law, and Graham's law of diffusion were all placed on a dynamical footing in this paper. The causes which contributed to it being denied publication in 1845 are difficult to find At the present time it suffers from having been superseded in style and argument by the work of successors When written, it apparently suffered from being in advance of its time. Joule's work on the dynamical nature of heat had been in part published, but the theory of conservation of energy was not authoritatively accepted until about six years later Even so late as 1848, Thomson (Lord Kelvin) wrote : "The conversion of heat (or caloric) into mechanical effect is probably impossible, certainly undiscovered. In actual engines for obtaining mechanical effect through the agency of heat, we must consequently look for the source of power, not on any absorption and conversion, but merely in a transmission of heat"

Who was the man whose scientific insight drew from Lord Rayleigh such high praise? In answer, Dr Haldane prefaces his collection by a short biography His grandfather was founder of an important (still existing) firm of manufacturers of sealing-wax and other stationery, his grandmother was a niece of Robert Sandeman, a well-known religious leader and founder of the body known as Sandemanians—to which Michael Faraday and his blacksmith father belonged—and sister of George Sandeman, who was founder of the well-known firm of port wine merchants.

Waterston himself went from school to the University of Edinburgh and studied mathematics and physics under Sir John Leslie, and was medallist of his year in Leslie's class. He also attended lectures on anatomy and surgery—probably drawn to these subjects by his father's and his own interest in phrenology. His first published paper was written in his student days when he was nineteen years of age (*Phil Mag*, 1831) It was an attempt to explain gravitation on dynamical principles. It is interesting, because in it there is the germ of the ideas which he developed afterwards in his more important paper. No further publication occurred until 1843, when an anonymous volume appeared entitled "Thoughts on Mental Functions" Here he sought to study metaphysics as a branch of the physiology of the nervous system Dr. Haldane remarks "The book is a very acute essay, far ahead of its time . . The idea which guided him

was that human behaviour can only express itself in material changes which must, in so far as they are intelligible, be dependent on previous material changes "

In the interim Waterston had become a pupil of James Walker, F R S , a leading civil engineer and president of the Institution of Civil Engineers, and was employed in connexion with the rapidly developing railway system of England He contributed to the Institution a paper on a graphical method of estimating the earthwork in embankments and cuttings. He felt, however, that his heart was in pure science and he obtained a post in the Hydrographer's Department of the Admiralty under Captain (afterwards Admiral) Beaufort, who encouraged his scientific ambitions, and later obtained for him the post of naval instructor at Bombay to the East India Company Cadets He held the post, except for a brief period, until 1857, when he returned to Edinburgh, where after some changes he ultimately settled down and remained until his death in 1883.

Various papers were submitted by Waterston to different societies and not all of them were accepted , this seems to have embittered him. His brother wrote of him : " He showed a restlessness and dislike at the mention of scientific men, except Faraday, and he used very strong language in respect to some who bulk largely in public estimation " Dr Haldane surmises that his real antagonism did not arise from the non-publication of his papers, but that he was critical of the leading physicists of his time, especially in regard to their thermodynamic reasoning. The chief support brought forward for this surmise is the mention in his will of an unpublished manuscript , but as this manuscript was never found, it is rather idle to speculate as to what the subject matter of it might have been The reviewer finds it very difficult to follow Dr Haldane's argument in the pages he devotes to this question Quite certainly there is nothing in Waterston's published writings to justify attributing to him the views which his biographer puts forward.

It is unnecessary to dwell on this aspect of Waterston's life He succeeded in getting papers published after his return, and there are many interesting questions dealt with by him. In 1858 (*Phil. Mag.*) he describes experiments on capillarity The argument he kept in view is that if the capillarity of a liquid is the exhibition of part of the cohesive force of the superficial stratum of molecules, numerical relations with the latent heat of its vapour ought to be demonstrable. The paper needs to be translated into modern language, but it is sound in idea. It may be recalled that Dupré later (1886) developed a similar question, and in recent years E T. Whittaker has displayed the close parallelism that exists between surface *energy* and the internal latent heat of evaporation. Waterston made a large number of experiments to bring out the connexion, and he deduced, for example, $1\ 45 \times 10^8$ as the number of layers of molecules in one inch in the case of liquid alcohol

Again, Waterston describes a number of experiments on the transition (that is, critical) point of liquids in sealed tubes after the manner of Cagniard de la Tour The tubes were filled to different amounts with the same liquid, and he found the densities of the liquid and vapour when the liquid state terminates He found that the cup shape of the upper surface of the liquid, caused by its capillarity, ceased at a temperature considerably under the point of transition and while the densities of liquid and vapour were very different These observations suggest Prof Callendar's recent experiments on steam (*Proc Roy Soc* , Sept. 1928), where about six degrees' interval is found between the two temperatures—the meniscus disappearing when the density of the vapour is only 0 6 of that of the liquid Waterston further claims to have observed that between these temperatures the surface became of ' a sugar-loaf aspect,' that is, convex upwards He argues from the data that the rate at which the latent heat diminishes with rise in temperature must augment with the temperature, otherwise the critical point would be much higher than it is. He observes that Regnault's curve for the latent heat of steam is discontinuous at 100° C , this is now a well-recognised fact

Waterston put forward views on chemistry of which Prof McLeod has said that they " shadow forth many of the ideas of modern chemistry which have been adopted since 1845 "

Altogether, from the historical point of view, it is a good thing that Dr. Haldane has done in editing these papers Crude they may seem to-day in many respects , but " nothing awakes on its hundredth year without both looking (and feeling) queer " , and it is almost a century since Waterston's first paper appeared What he did, he achieved by very simple means, and modern progress has demonstrated that often elaborate means are essential so that his work was really pioneer work We may sum up by again quoting Lord Rayleigh : " To say that he was not always successful is only to deny his claim [not made by himself] to rank among the very foremost theorists of all ages "

A Biologist as Ethnologist.

L'Industrie des pêches au Cameroun Par Dr Théodore Monod. (Commissariat de la République Française au Cameroun, Mission Monod (1925–1926): Première partie, Généralités) Pp 509+25 planches (Paris Société d'Éditions Géographiques, Maritimes et Coloniales, 1928) 90 francs.

RENAISSANCE of interest and pride in their colonial possessions are outstanding and most satisfactory features among the French of to-day. Prior to the War few Frenchmen went abroad, apart from Algeria, as colonists and planters, and, with some brilliant exceptions, the officials sent overseas were men of inferior quality, of whom their political party or their departmental chiefs were anxious to be quit Their salaries were often mere pittances, and their numbers, judged by the British standard, out of all proportion to real requirements ; the sum total of their salaries was frequently excessive as compared with the revenue of their particular colony and a distinct impediment to development and progress Bureaucracy strangled enterprise even among their own countrymen, and French colonial administration was a synonym for inefficiency and red-tape

To-day much of this is changed. A superior class of official is in evidence , better-class families in France no longer frown upon a colonial life as a career for their more adventurous sons. The Colonial Administration at headquarters is correspondingly enlightened and has had the wisdom to obtain the co-operation of the scientific staff of the National Museum of Natural History in their efforts to develop colonial resources. The outcome has been the establishment of the Laboratoire des Pêches et Productions Coloniales, under the able direction of Prof A Gruvel, nothing quite comparable with this very useful institution exists in Britain, though by one means or another the needs of the British colonies in this respect do get fairly well met through the willing co-operation of various scientific and technical institutions.

So far as British West African colonies are concerned, no work has been published comparable with the fine monograph by Dr Théodore Monod upon the fishing industry of the Cameroons, of which the first volume has recently appeared. A bulky tome, it gives in great detail a vast mass of information, technical, ethnological, and linguistic, touching the existing fisheries of the various hydrographic regions into which the territory is divided—the coastal, the riverine, and the lacustrine. The present volume deals mainly with the technical and economic aspects, the next will contain the systematic reports of specialists upon the scientific collections made during the various tours The investigation carried out by M Monod, the delegate of the Colonial Fishery Laboratory, lasted rather less than one year , the results reflect the greatest credit on his energy ; their presentation is on the whole admirable, but suffers, alas ! from the absence of any index or detailed table of contents. Comparative references in consequence are made with difficulty, and the trouble is accentuated by lack of sufficient correlation between the text and the numerous illustrative line figures, charts, and diagrams

The facts recorded are probably of even greater value and interest to the ethnologist than to the fishery expert, and the lack of index is a serious handicap when comparing the methods and appliances of the various tribes The extraordinary variety of the fishing devices in daily use and the complexity of several reveal the intellect of certain tribes as much more versatile and adaptative than is generally credited The ingenuity shown is often surprising , perhaps even more remarkable is the parallelism between many of the more specialised of these methods with those in India It is needless to particularise Practically every device from the simplest to the most complex employed on the rivers and lakes of this part of Africa has its counterpart under similar conditions in India. M Monod appears not to appreciate this , he envisages the *local* evolution of such a complicated engine as the great balanced dip-net (*zemi*) worked from large canoes by the Kotokos, from the triangular hand-net used for dipping out prawns and small fish, a conclusion which does not take account of the presence of the counterparts of this *zemi* on the Ganges. Complex devices are seldom evolved separately; through cultural contact they are passed from people to people, and the facts recorded in this volume support the view of the close relationship of certain of the pre-Aryan peoples of India with the Hamites of Arabia and Africa, through whom part of the common material culture has filtered to the Bantus and to a slight extent even to the Sudanese negroes.

Such ethnic problems are, however, of academic interest , another aspect of local ethnography has extreme practical importance, and ethnography is inextricably mixed up in the fishery problems of the Cameroons. Certain tribes have neither aptitude nor inclination to utilise the fishery

resources of their tribal territories, others are extremely skilful and resourceful in fishing and make the most of their opportunities But prejudice and tribal ties restrict their operations to a definite area, and many stretches of fecund waters are neglected for want of a population interested and adept in fishing Natural indolence is another factor in limiting fishing in many localities to a minimum; there, the people fish only when they feel inclined for a change of occupation No real or professional fishing exists among such people, whose attitude is typified by the remark of a Duala—" This fish-work live for kill man, Massa "

The author's conclusions do not encourage the hope of the successful establishment of any extensive fishing enterprise undertaken by Europeans, except perhaps in deep-water trawling, about which data are too inadequate to permit of a definite verdict Here, by the way, M Monod has been misinformed in regard to trawling off the Sierra Leone coast (footnote on p 33). in 1912 a steam trawler worked very successfully off this coast, but the enterprise ended in failure through mismanagement and boycott by the market people

The present methods of the indigenous population are usually well adapted to local conditions, and it is rather initiative and application that require to be fostered than the introduction of new appliances. Where improvement is most desirable is in the curing of the product As is usual in West Africa, the ordinary cure is a combination of desiccation by artificial and intense heat with concurrent smoking. Little was done to investigate the lines on which improvement may be effected; M Monod is a biologist who worked single-handed on an inquiry of extremely wide scope, and it is obvious that this industrial phase of the subject should be taken in hand by one who, besides possessing intimate acquaintance with curing methods, has had a scientific education as a bio-chemist.

James Hornell.

Detection of Poisons.

Laboratory Manual for the Detection of Poisons and Powerful Drugs By Prof Dr Wilhelm Autenrieth Authorised translation by Prof William H Warren Sixth American edition from the fifth German edition, completely revised with extensive Additions. Pp. xxvi + 698. (London J and A Churchill, 1928.) 30*s* net

TOXICOLOGY is admittedly one of the most difficult subjects to handle adequately The student is faced with three serious obstacles. toxicology requires a considerable period of uninterrupted study, a period which he can seldom afford, the necessary laboratory facilities are not easily found, and finally, after mastering the principles of his art, he is rarely fortunate enough to come across sufficient opportunities of practising them. In the East, of course, where from time immemorial the professional poisoner has been rivalled by the gifted amateur, there is no lack of scope for the toxicologist, both in his chemical and also in his forensic capacity

Autenrieth's well-known manual, now appearing in English as the sixth American edition, suffers somewhat from the failure of the translator to bring it completely up-to-date The author gives general methods of handling cases, wisely stressing the impossibility of conducting a toxicological examination on any fixed plan, and rightly indicating that all details connected with the case, such as the medical history—especially a list of all drugs administered—and the results of the post-mortem examination, should be given full consideration The method of examination to be adopted depends in many cases upon the toxicologist's experience

The reviewer believes that the book would have been rendered still more useful by including a really comprehensive summary of recent work published in the technical press, with fuller references to that done elsewhere than in Germany The following detailed criticism is offered in support of this belief Under the head of prussic acid poisoning, no mention is made of the delayed form caused by eating cyanogenetic glucosides. The symptoms and post-mortem appearances are very puzzling until the cause is recognised

Poisoning due to the absorption of nitrobenzene from shoe polishes has been mistaken, clinically, for poisoning by prussic acid, and might be mentioned under the appropriate head Death from drinking formalin may take place in *less* than three hours The reviewer saw one case where a man swallowed one ounce of so-called '40 per cent formalin' and died in about twenty minutes. The stomach resembled a tough fibrous mass the size of a cricket-ball.

It is somewhat surprising that in a book revised by an American so little is mentioned about the toxic effects of methyl alcohol, and that only German references are given Under the head of picric acid, surely some of the information available since the War on this substance and dinitrophenol might have been incorporated

The one-sided nature of the references is illus-

trated by the fact that the Crippen case is not even mentioned under the mydriatic alkaloids group, and the method described in the text of identifying cocaine by the potassium permanganate test is quite useless when really small quantities have to be identified Hankin's modification of the test, published in 1911, is not mentioned, although it is extraordinarily delicate The reviewer has used it for years and cannot speak too highly of it The methods of detecting and estimating arsenic might be condensed with great advantage, and the section on the toxicology of lead would be more valuable if adequate references were given to the enormous literature of the subject Lead tetraethyl is not even mentioned , in fact, the section dealing with metallic poisons is very unsatisfactory.

The treatment is quite inadequate elsewhere, as illustrated by the section on boric acid as a food preservative, the only reference being to a dissertation published in Munich in 1883 as so much of the valuable work on this subject was done in America, it is quite extraordinary that, in an American translation, no mention is made of Dr Harvey W Wiley. In like manner the section on carbon monoxide poisoning might have been written twenty years ago Surely references might have been made to the large amount of recent work

Another example is that of aconitine, the treatment of which is not up-to-date, the well-known test for which, first described by the late Sir Thomas Stevenson, is ascribed to Fuhner in 1911 ! The comparison of frog heart tracings on a kymograph is not described. No mention is made of the identity of yohimbine and quebrachine, and the importance of detecting oxydimorphine in certain cases of suspected morphine poisoning is neglected The section on blood stains and the detection of human blood suffers from the same defects, and requires extensive re-writing. The amazing statement is made that " if the blood stain is perfectly fresh, it may be recognised by observing blood corpuscles with the microscope Human blood may be differentiated from animal blood by comparing blood corpuscles with those of animal blood as to size, only when the corpuscles are still intact " Further on, however, the biological detection of human blood is dealt with, although in a most inadequate manner, no mention being made of Nuttall, or of Dale's anaphylaxis method.

The index is poor, and the apparatus described is in most cases archaic. The printing is very good, but the binding is not strong enough to withstand the amount of handling such a book would receive as a constant laboratory companion. K C B

Our Bookshelf.

Allen's Commercial Organic Analysis. a Treatise on the Properties, Modes of Analysis, and Proximate Analytical Examination of the Various Organic Chemicals and Products Employed in the Arts, Manufactures, Medicine, etc Vol 6 *Colorimetry, Dyes and Colouring Matters, the Synthetic Dyestuffs, and the Analysis of Colouring Matters* By the Editors and the following Contributors . W A Gallup, Hans Edward Fierz-David, A W Joyce, and V E. Yarsley Fifth edition, revised and in part rewritten Editors Samuel S. Sadtler, Dr Elbert C Lathrop, C Ainsworth Mitchell Pp ix + 658 (London J and A Churchill, 1928) 30*s* net

THE seventh volume of this work is considerably different from the corresponding volume in the previous edition Such subjects as tannin, natural colouring matters, and inks, which were included with synthetic dyestuffs in the old edition, have already been dealt with in Vol 5 of the new edition The new book, therefore, is confined practically to an exhaustive study of the preparation, structure, and analysis of synthetic dyestuffs In addition, there is, however, a small well-written section on colorimetry, which might with advantage have been considered in the same volume with other physicochemical determinations

The largest section of the work consists of an article on dyes and colouring matters, in which dyes are classified on chemical lines on the method of Schultz's "Farbstofftabellen" and of the "Colour Index" Importance is placed on absorption spectra as the quickest method of identifying a particular compound Synthetic dyestuffs, the next largest section, are concerned with the constitution of various dyes by their reduction products The remaining chapters deal briefly with the analysis of colouring matter on the lines of A G Green's "Analysis of Dyestuffs," which the authors use as the main source of reference

The editors have been careful to prevent much overlapping, especially in the closely connected second and third sections, and the work as a whole is well up to the standard of the previous edition. There is, however, a slight tendency for it to take the character of a book on special branches of organic chemistry for the specialists, rather than a book of commercial organic analysis of particular value to the analyst The general production of the present volume, both with regard to printing and paper, is excellent, and comparatively few misprints have been noticed J REILLY.

Handbuch der biologischen Arbeitsmethoden Herausgegeben von Prof Dr. Emil Abderhalden. Lieferung 266. Abt 2 *Physikalische Methoden*, Teil 2, Heft 8 *Die Methoden der Erdbebenforschung*. Von Friedrich Errulat. Pp 2151-2262 (Berlin und Wien · Urban und Schwarzenberg, 1928) 6 gold marks.

THE first work in which the modes of investigating a great earthquake were described was Robert Mallet's report in two large volumes on the

Neapolitan earthquake of 1857 (published in 1862) Since then, though methods of studying perceptible earthquakes have been given in various papers, there has been a great want of a more complete treatment of the subject, such as is attempted in this part of Abderhalden's "Handbuch" About two-thirds of it is devoted to microseismic methods, to descriptions of the various instruments employed, and to the interpretation of seismograms Two useful diagrams (on pp 2156-57) illustrate the advantage of damping, one showing the similarity of the records of the same earthquake by two damped pendulums (Wiechart and Mainka), the other giving records of the same earthquake by undamped and damped pendulums.

The next section, on the investigation of perceptible earthquakes, is slighter than the other The author quotes Sieberg's list of questions, the Sieberg and Mercalli-Cancani scales of intensity, and the Sieberg scale of sound-intensity The questions seem too numerous for general use, the Sieberg scale of intensity contains too many tests for each degree, leading to the irregular construction of isoseismal lines, while a scale of sound-intensity depends on a very variable instrument—the human ear—and can only be of service when the number of observations is very large In the remaining sections are described very briefly the investigation of submarine earthquakes, of the causes of earthquakes and related subjects (such as periodicity), of the geographical distribution of earthquakes, of microseismic motions, and of the methods of applied seismology If, in parts, the treatment is somewhat scanty, this is a defect that may easily be remedied in a later edition of a very useful work. C. D.

Buried Treasures of Chinese Turkestan an Account of the Activities and Adventures of the second and third German Turfan Expeditions By Prof Albert von Le Coq. Translated by Anna Barwell. Pp 180 + 52 plates (London: George Allen and Unwin, Ltd, 1928) 18s net

Prof. A von le Coq gives a vivid account of two expeditions to Eastern Turkestan on an archæological mission from the Berlin Ethnological Museum. After giving a historical survey, the labours and excitements of the expeditions are narrated, and incidentally there are ethnographical observations and descriptions of archæological remains At one place the expedition arrived too late to save some remarkable Sassanian-Hellenistic paintings, and cartloads of Manichæan manuscripts had been thrown into the river by peasants, as paintings of persons are an abomination to Moslems, they are usually destroyed whenever found Another library of priceless manuscripts had been destroyed in the course of time by water Though there were frequent disappointments, various sites offered a rich harvest of frescoes and other objects which can now be seen in Berlin

The narrative is illustrated by beautiful photographs of scenery, people, monasteries, rock-temples, and the like, and especially of Hellenistic statuary and wonderful frescoes. A reader desiring more detailed information than the somewhat slight amount supplied in this book is referred to the large number of publications which are mentioned in an appendix

The Great Chemists By Dr. Eric John Holmyard. (The Great Scientists Series) Pp. vi + 138 (London Methuen and Co, Ltd, 1928) 3s 6d. net.

This interesting work is essentially a short history of chemistry, written in a very attractive and informative manner. Dr. Holmyard has shown great skill in weaving the story of the 'Divine Art' about the lives and works of outstanding alchymists, chymists, and chemists, as he follows his pleasant path down the ages from ancient times to the present day. Each of the 'great chemists' is chosen as typical of his period, and the names are Jabir, Razi and Ibn Sina, Roger Bacon, Paracelsus, Boyle, Stahl, Priestley, Lavoisier, Dalton, Avogadro, Davy, Liebig, Kekulé, Pasteur, Arrhenius, Mendeléeff, and Ramsay Few readers are likely to cavil at this selection, which manifestly fulfils the author's purpose of imparting a sense of historical continuity to his narrative It is interesting to notice in passing that the list includes five Englishmen and one Scotsman As would be expected, other names are to be found in the text the index refers to more than thirty workers in the cause of chemistry, the most notable absentees which occur to us being the enigmatical Basil Valentine and that potential Lavoisier of the seventeenth century—John Mayow The authoritative chapter on Jabir is to be particularly commended J R

Elements of Optics By Prof. Joseph Valasek. (General College Physics) Pp. xiii + 215 (New York McGraw-Hill Book Co, Inc, London. McGraw-Hill Publishing Co, Ltd, 1928) 10s net

This is an attractive little book on 'light' which would form a good introduction to the subject for those who will not be concerned with technical applications of geometrical optics The sign convention employed by the author would be very confusing in the treatment of any problems but those of thin lenses, and no attempt is made to discuss more complex optical systems on Gaussian lines, except for a short paragraph on thick lenses The discussion of aberrations is limited to brief notes on spherical aberration, chromatic aberration, and astigmatism in their geometrical aspects

Apart from these deficiencies, the chapters on physical optics are well written, and the sections on colour, radiation, double refraction, and the like, bring the older material into co-ordination with modern ideas. The mathematics used is confined to elementary algebra and trigonometry

In a book on optics which discusses quanta and spectral series, etc., it is a little surprising that some of the results of the electromagnetic theory should not be used to discuss such topics as reflection Material of this kind should replace the interesting but unnecessary account of 'relativity.'

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Spectrographic Chemical Analysis.

METHODS devised for the spectrographic analysis of mineral substances were described and results given by the late Prof. Sir W N. Hartley and myself in a series of papers published in the period 1897–1901 (*Trans Chem. Soc*, **71**, 583, 1897, and elsewhere) Those methods, however, do not appear to have been utilised by any other workers except one, the late M A de Gramont

In the simplest method then described, a weighed quantity, up to half a gram, of the powdered mineral (the exact weight depends on the type of spectrograph and the type of mineral) was tightly rolled in one half of an ashless filter paper and the roll burnt in an oxy-hydrogen or oxy-coal gas flame before the slit of a quartz spectrograph, a quartz lens being used to focus the image of the flame on the slit. The elements which may be detected by this method when present in small quantities are: All the alkalis, copper, silver, magnesium, calcium, strontium, barium, gallium, indium, thallium, lead, chromium, manganese, iron, cobalt, nickel, palladium, ruthenium, rhodium, phosphorus, bismuth, and iridium Other elements which may be detected when larger quantities are present are · Gold, beryllium, zinc, cadmium, boron, aluminium, yttrium, tin, arsenic, antimony, sulphur, selenium, tellurium, etc.

The list, however, may be extended by placing the poles of an arc lamp horizontally in the flame, a little higher than the point at which the roll of filter paper is being burnt, and adjusted so that the image of the arc is focused on the slit The delicacy of the test is greatly increased on striking the arc, and, in addition, elements such as titanium, molybdenum, and tungsten, etc, give lines instead of only a continuous spectrum. Experiments so far made indicate that this is a promising field for investigation.

The spectrograph used by me since 1913 is a Size C Hilger quartz spectrograph (purchased with a grant from the Royal Society Government Grant Fund) and it gives very satisfactory results The photographic plates generally used have been Ilford panchromatic coated on thin glass Plates 5 in. × 4 in., suitably placed in the holder, cover the region required in most work, namely, from the red to beyond λ2800, that is, when no arc is used. The filter papers recommended are Munktell's Swedish, No 00, diameter 12 5 cm. This spectrograph and method have been used, qualitatively and quantitatively, in the analysis of flue dusts containing gallium and in extracting gallium from flue dust. It is seldom necessary to take more than 0 1 gm, and smaller quantities usually suffice

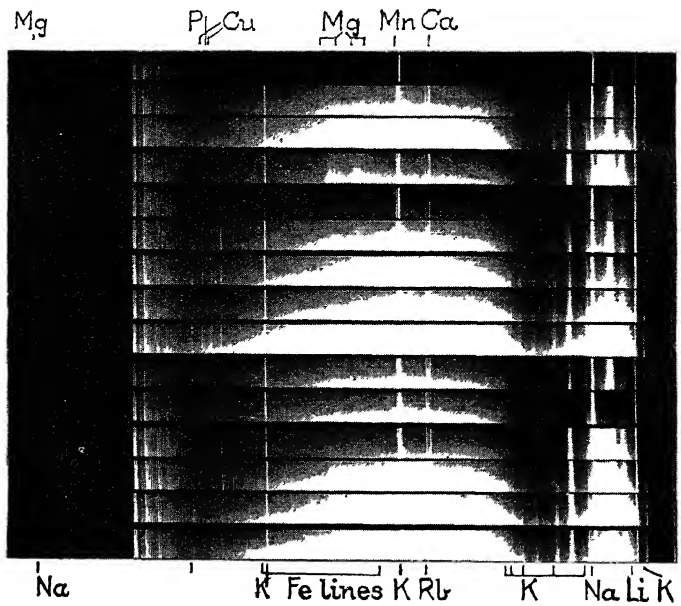

FIG 1 —Stem of wheat grown in soil to which lithium, potassium, and rubidium salts were added Top four spectra leaves, next four sheaths, next three grain, stem, and chaff of ear, last four straw sections The first of each set of four was the oldest and the others follow in order of age Cut when the ear was nearly half filled

The method has also been applied to the analysis of vegetable and animal substances In examining vegetable material, the twig, straw, leaf, or other part is held by forceps and burnt in the flame without introducing any impurity, even in the form of ashless filter paper By taking weighed quantities, usually 0 1–0 25 gm, the quantities of the mineral constituents can be compared, as, for example, in plants grown in different soils, etc, or in plants such as wheat at different stages of growth, or before and after watering with mineral salts. Many interesting results have been obtained in this way.

As an example it has been established that rubidium is very widely distributed in soils and in the plants grown on them Further, the growing point of cereals is relatively richer in rubidium, as compared with potassium, than the other parts of the plant It is possible that rubidium is more freely absorbed than potassium, as potassium seems to be more freely absorbed than sodium, but it seems more probable that potassium and rubidium pass up in the sap with equal freedom and that the potassium diffuses or transfuses more readily away from the growing point.

Animal matter, or soft vegetable substances, may be examined by rolling 0 5 gm. in ashless filter paper, but it is better in most cases to dry them in a steam oven and to take 0 05 gm of the powdered dry residue in a smaller piece of filter paper The various organs of an animal may easily be compared for mineral constituents in this way

In some experiments a wheat straw with ear has been divided into eighteen parts: grain, leaves, sheaths, and sections of straw, and the eighteen spectra photographed on one plate so that comparison is easy and the record is permanent, the burning occupies twenty to twenty-five minutes.

During the recent vacation, experiments were made with measured quantities of blood, and it was found that the best results for comparison were obtained by taking 0 1 c.c. on ashless filter paper. Samples of

normal blood and two samples from anæmic patients, kindly supplied by Dr. G. P. Claridge of Norwich, were analysed and distinct differences were noted in the iron, calcium, magnesium, and potassium content. Further, the rubidium line λ4202 was present in the spectrum of the normal blood; rubidium, in fact, is present in most parts of the body, and it is present in both human milk and cow's milk.

It will be seen that there should be many applications for methods of spectrographic analysis on the lines described above. The spectra contain few lines

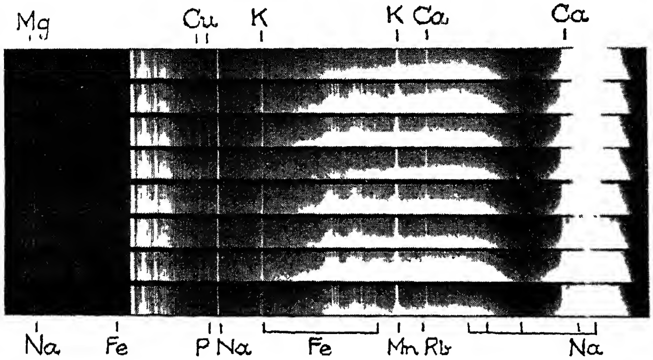

Fig. 2.—Parts of body, dried at 100° C., 0·05 gm. of each: 1 (top), cartilage, epiglottis; 2, spleen; 3, kidney; 4, lung; 5, abdominal muscle; 6, heart muscle; 7, brain; 8, liver.

as compared with arc or spark spectra, and the lines are easily identified in practice. The methods are worthy of more attention than they have received and they should be especially useful, and possibly prove indispensable, to those interested in the detection and distribution of the metals essential to life, and even of phosphorus, in the parts of plants and animals.

Hugh Ramage.

Municipal Technical Institute,
Norwich.

Evolution through Adaptation.

Dr. Bather's interesting survey of "Evolution through Adaptation" in Nature of Mar. 30 prompts a few supplementary suggestions. There is a tendency in writing upon this subject to think of 'a variation' appearing in the soma under some stimulus which, if maintained for a sufficient number of generations, may produce in the germ a mutation in harmony with the variation in the soma. The concept of a mutation of the germ, arising in such a way as to harmonise with an alteration in the soma that has already appeared, is a concept which strains probabilities in many, though not necessarily in all, types of cases. Dr. Bather's illustration of an animal with defective pigment and sight skulking in dark corners, where alone it is likely to escape its enemies, is used by him to suggest selection of environment by organism, but it is also a reminder to come back to thought of the organism as a whole.

Experiment and observation have shown that considerable alterations in the balance of growth can be produced in a population through alteration in environmental influences. Such influences operate in Nature generally; we have clear evidences of secular variations of climate through the geological periods, and we know that, in spreading, a form of life encounters modified conditions as its range extends itself.

Observation and experiment further show that for various stocks there are 'fringing conditions' under which the individual can indeed live, and even, it may be, grow, but the race cannot reproduce itself, or can do so only very exceptionally. The sensitiveness of the reproductive process is a noteworthy fact.

If now we set these two points side by side, we may picture a 'marginal case'. Let us suppose that the changed conditions of the environment have induced changes of growth, but that the germs remain as before. These germs are presumably like all living things in that no two are alike. Some variations in them may be towards greater, and some towards lesser, viability in the altered environment. It will be from the former that the survivors will be bred. We thus think of a process of selection operating on the germs, and operating so as to eliminate, very probably, quite a large proportion of them. It is a selection not of a germ that has mutated so as to produce a change in harmony with some change that has appeared in the soma, but a selection of a germ viable in an altered environment. The plea here is one which to some extent supplements Dr. Bather's suggestions, or, for that matter, Prof. Lloyd Morgan's concept of organic selection, for it demands less in the matter of variation of the germ. It looks upon variation of the environment of a stock, whether because that stock spreads in space, or lasts through phases of climatic change, as in some sort the initial factor, and it suggests that the extra sensitiveness of the reproductive process, as compared with the other vital processes, is one of the main determinants of the viability of a stock in a fringing zone of distribution. It looks upon the germ as basic capital undergoing slow modification, less through the addition of particular mutations corresponding to changes already in the soma than through the selection under marginal conditions of viable variants.

These suggestions are in no way in opposition to Dr. Bather's, nor does the point of view here developed conflict with that of the advocates of organic selection. It merely attempts to supplement them by burrowing under the problem of the inheritance or non-inheritance of acquired characters. It leaves abundant room for the idea of evolution by germ-mutations and so on, and it suggests that growth changes may be essentially physiological responses, some of which may increase, others decrease, viability. It leads on to the suggestion that, as cumulative growth changes occur as responses to cumulative environmental change, and are themselves followed, at a long interval, by attunements of the germ which are attunements to environmental changes, the germ in the course of its evolution becomes more and more highly specialised the more and the more recent and the more rapid have been its attunements. Thus, if a new series of environmental changes should afterwards supervene, such a highly specialised organism would be less likely to be able to respond than would a less specialised form, a form which had had a longish record of relative evolutionary passivity.

H. J. Fleure.

Aberystwyth.

Prof. Fleure is careful to explain that his remarks are not in criticism of anything said by me; yet they seem intended to evade the difficulty that I have found in certain beliefs for which there does appear to be some evidence—the difficulty, namely, of understanding why and how a germinal mutant does appear sometimes to accord with a previous modification of the soma. Prof. Fleure says this "is a concept which

strains probabilities." Many biologists of no less distinction have regarded the concept as more than probable It is by no means clear that such examples of the transmission of impressed characters as Prof. Przibram brought to our notice the other day fall within this concept. they seem to be instances of reversible modification Among facts that do support the concept are those genetic analyses of populations adapted to a special environment which have shown that the adaptive characters of some individuals are due to somatic modifications, while those of others are inherent in the germ Cuénot ("L'Adaptation," 1925) cites in illustration *Centaurea jacea*, forma *humilis*, in the Swedish salt-marshes, Gregor and Sansome (*Jour. Genetics*, **18**, p 349, 1927) have traced a similar mixture of mutants and modifications in wild grasses The bearing of these observations on adaptive evolution was discussed in my presidential address to the Geological Society (1928).

In the explanation of adaptation now put forward by Prof Fleure it is not easy to detect anything more than the old Darwinian idea of indefinite continuous variation and selection of such forms as can live in the changed environment Let the environment change ever so greatly, some of the germs will be able to persist, and so the line alters from species to species, and from genus to genus (or grade to grade), without any actual change in the germ The original germ has in it the potentiality of all this development If this is what Prof Fleure means, surely he is basing his conclusions on a view long since discarded. It is generally agreed now that there are limits to fluctuation, just as there are to individual modification

A palæontologist can produce no evidence for or against such a view, he is bound to consider the evidence of workers in other fields, and this, at present, indicates that change (mutation) does affect the germ, and that successive mutants, by however little they are distinguished, are actually discontinuous Evolution is by quanta Accepting this, the palæontologist applies it to the phenomena with which he is familiar, and his analysis, if carried far enough, will lead him to those questions to which my Royal Institution discourse attempted to suggest an answer When Prof. Fleure writes of "attunements of the germ . . . to environmental changes," he merely states in metaphorical language a fact which—if it be a fact—demands an intelligible mechanism. F. A. BATHER

Spiral Markings on Carborundum Crystals.

THE phenomenon described by Prof A. W. C. Menzies and Mr. C A Sloat in NATURE for Mar 9, p 348, can, I think, be explained from some results I obtained in 1925 in connexion with the banded crystallisation of sulphur films.

The inside of a test-tube was covered with a film of molten sulphur by vigorously boiling some of the substance inside. The test-tube was then lightly plugged with cottonwool and allowed to stand upright. After the draining film had cooled almost to room-temperature in a few minutes, centres of crystallisation appeared at various points, and rings could be seen growing in succession outwards from the central points. The accompanying enlarged photograph (Fig. 1) of the test-tube shows the result.

I found that good rings were obtained in hard glass test-tubes, or soft glass which had been cleaned with concentrated sulphuric acid, but that only poorly developed rings could be got in ordinary soft glass test-tubes, particularly if alkali was present.

I also found that by counting the number of rings from a centre and measuring the distance also from the same centre occupied by these rings and then plotting the logarithm of the number against the logarithm of the distance, an excellent straight line was obtained in every case. In one experiment I counted 89 rings or parts of rings in one direction from the centre

The general equation for these straight lines is

$$\log N = a \log r + \log K$$

where N = number of bands, r = distance, $\log K$ is the intercept on the axis of $\log N$, and a is the slope of the line to the axis of $\log r$ This gives

$$N = Kr^a$$

as the law of formation of the rings.

The explanation of the formation of the rings I had arrived at and considered satisfactory was that the first small crystal formation at the centre caused evolution of latent heat which consequently rendered

FIG 1

the surrounding sulphur more mobile and diminished its surface tension This mobile ring of liquid sulphur was then drawn outwards away from the centre to form a circular ridge, which, however, very quickly crystallised with liberation of more latent heat and formation of another mobile ring, and so on. That the sulphur is drawn away from the centre by surface tension is clear from the photograph, because the centre is a depression, not an elevation. Also the flow can actually be witnessed by means of a lens during crystallisation

It seems that the sulphur has to be in the labile state for these rings to form. If it is in the metastable state, then only large crystals grow slowly in the film. Some of these can be seen as irregular patches in the photograph.

I have measured the rings in the photomicrograph reproduced in Messrs. Menzies and Sloat's communication (*loc cit*), both in the direction west of the centre and in that N N W. of the centre, and find that the logarithm of number against logarithm of distance give beautifully straight lines In the case of the latter direction (N.N.W) a is very nearly unity and K 0 417 mm.$^{-a}$.

I would therefore suggest that the spiral formation observed by them has been produced in a similar manner to the sulphur rings described above Further-

more, there appears to be no particular significance in the spiral nature of the markings. It may be noted that Hedges and Henley (*J. C.S.*, October, p. 2725; 1928), in connexion with their work on Liesegang rings, describe spiral formations as anomalies due to accidental external conditions.

William Hughes.
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Southampton

A Principle of Duality and the Causal Law.

The possibility of a causal space-time description of experience has recently been often denied, and emphasis has been laid upon the purely statistical validity of quantum-theoretical relations. This denial of a possible causal space-time description has aroused suspicions and diffidence in regard to the newer physics. The purpose of this note is to show that there is no need for the above denial and that we have not only one possibility of a causal space-time description of experience, but actually two of them. This superabundance of possibilities of description is the very reason, as we shall see presently, why some relations can have only statistical validity.

It is well known that light can be described either as a propagation of spherical electromagnetic waves or as the linear translation of corpuscles of energy and momentum (light-quanta), that electrons appear sometimes as point-charges and at other times as matter-waves; that the atom itself can be pictured, in the case of hydrogen, either as a planetary system of attracting particles (Bohr's theory) or as a system of stationary waves (De Broglie, Schrodinger). Furthermore, it is easy to show, as will be done more fully elsewhere, that the process of emission of light can be described either as the sudden spontaneous ejection of a light corpuscle, a finite time (*Verweilzeit*) after the excitation, or as the continuous radiation of a set of spherical damped waves beginning at the very moment of excitation, the inverse of the damping coefficient of which is equal to the extinction-time (*Abklingzeit*); that absorption can be interpreted either as the sudden jump of the molecule from one stationary state to another owing to the impact of a light quantum, or as a classical damped resonance of the molecule with the on-coming wave, that optical resonance appears either as sudden absorption with subsequent sudden emission after a time determined by a coefficient of 'spontaneous' transition or as continuous scattering (dispersion), in which the secondary radiation is coherent with the primary (Wood's experiment showing regular reflection of mercury vapour for $\lambda 2537$). Moreover, Schrodinger (*Ann. d. Phys.*, **82**, 257; 1927) has shown that the Compton effect can be described from the point of view of waves as well as of corpuscles, and Heisenberg (*Zs. f. Physik*, **40**, 501, 1926) has made clear that both points of view are equivalent in explaining the phenomena of fluctuation. Photo-effect and electron-collisions can also be described equally well from either viewpoint.

All of the examples given above show clearly that there are many physical phenomena which can be described in two ways, using either one of two essentially different systems of concepts and definitions. The two systems by no means complement each other; *they exclude each other*. Every attempt to superpose the two descriptions in order to reach a unified one leads necessarily to breaks in the laws of conservation of energy and momentum, as has been shown by the many unsuccessful attempts to describe light as energy-momentum centres moving along the Poynting's vector of a wave-field (virtual or probability waves).

Now it is easily seen that a space-time description is readily possible using either one of the two systems of concepts and definitions (waves or corpuscles) so long as we keep inside of one of them, and that in this case there is possibility of predicting the future of a physical aggregate, which is limited only in the case of a corpuscular description by the principle of indetermination of Heisenberg and Bohr. The classical claim of causality can be maintained in each system. In the corpuscular system we must realise that it is impossible to determine all of the initial conditions of a physical aggregate beyond a certain degree of accuracy. This limitation is unnecessary in a wave-description, since the principle of indetermination is superfluous in this case. The classical claim of causality is met here without restriction.

The causal space-time description of the whole of physics remains for the present only a programme, in spite of the dual possibility, owing to the fact that certain phenomena, like interference, can be described satisfactorily as yet from only one point of view. In an all-embracing quantum theory, therefore, it is necessary at present to make use of both systems of concepts at the same time and to jump from one to the other according to the exigencies of the case. At the instant of the jump, every possibility of a space-time description disappears, and the magnitudes calculated in one system can have only statistical validity in the other. This is the deeper reason for the purely statistical validity of some relations of quantum mechanics.

The breaks in the space-time description of experience are only a sign of the times, and we may hope in the near future to be enabled to make a causal description of physics in space and time, using a single set of concepts and definitions.

E. Gaviola.
Department of Terrestrial Magnetism,
Carnegie Institution of Washington,
Feb. 11.

Diffraction of X-rays by Two-dimensional Crystal Lattice.

In usual experiments with diffraction of X-rays by crystals, an effect of space-lattice is always observed owing to the penetration of the rays into the depth of the crystal. The thin layers, however, in which one

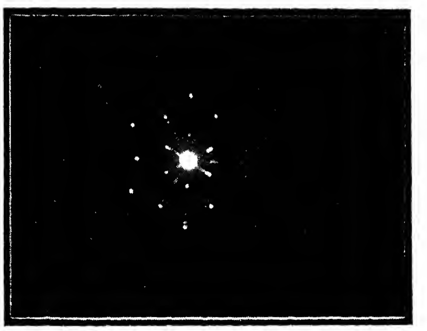

Fig. 1.

could expect the appearance of diffraction by the two-dimensional lattice, scatter the rays too little, and therefore the experiment becomes impossible. The matter is different in a crystal cleft into very thin layers in such a manner that the orientation of separate layers is not destroyed. This may be well

done in mica simply by heating it to red heat and then cooling, but not so well by carefully crushing plates of other crystals When a thin beam of X-rays passes through such a plate, the effect of two-dimensional lattices will be added, whereas the space effect will be destroyed by the incoherence of waves produced by scattering from incorrectly spaced layers

On the photograph (Fig 1) obtained by this method with Cu-radiation from mica, is seen a system of spectra corresponding to a series of two-dimensional lattices making different angles with each other.

From the measurement of these spectra the distribution of molecules in the layers of mica may be determined. All the spectra obtained may be explained by assuming that the molecules are distributed in the summits of equilateral triangles the sides of which are equal to 5·2 A

The phenomenon is quite analogous to the diffraction of cathode rays from mica obtained by Kikuchi (*Japanese Journal of Physics*, vol v No 2).

Somewhat more diffused photographs by the same method are obtained from gypsum and Iceland spar

A photograph taken of a crystal before cleavage gives the usual Laue figure

Owing to the facility of interpretation of the spectra of a two-dimensional lattice, this method may be of service in the study of crystal structure

W LINNIK

Leningrad Optical Institute.

High Frequency Discharge in Gases.

FOR some time past we have been studying the problem of high frequency discharge through air and other gases. In the course of our investigation we found that whether the electrodes are of external metal sleeves or are of internally sealed aluminium wires, steady striations always appear in the tube under suitable experimental conditions Recently

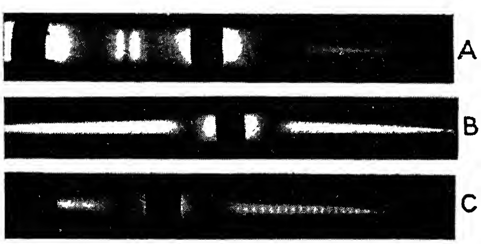

FIG 1

Heidemann (*Ann d. Physik*, **85**, Nr. 6, 1928) and Dr S P. McCallum and Mr W. T. Perry (NATURE, Jan 12, 1929) have observed striated discharges in hydrogen and argon with external electrodes The general nature of the striated discharges appears to be the same in all gases. Over and above what they have noted we have been able to observe certain new characteristic features of the discharges

(1) There is a striking difference in the nature of striations with internal and external electrodes. Whereas with external electrodes the striations are generally of the nature of 'double-layers' (Heidemann and McCallum and Perry), with the internal electrodes they have always a comb-like appearance excepting at very low pressures.

(2) As the pressure is lowered the thickness of the striæ increases At a still lower pressure the glow extends *beyond* the electrodes and striations can be observed in this region also (Fig. 1A)

(3) The same glow discharge can be obtained with only one external electrode. In this case the discharge is always of the form of two convergent beams with their apexes away from the electrode (Fig. 1B). The beams after converging, however, again begin to diverge from the apexes. It will be noticed that there are two very prominent dark spaces in the region beyond the electrode Beginning from this the discharge generally passes into a uniform glow But, with suitable pressure and power regulation the glow can be made to break up into striations (Fig 1C) It will be seen from the photographs that these striations become more prominent as the distance from the electrode increases

BHABESH CHANDRA MUKHERJEE.
ATUL KRISHNA CHATTERJI
Wireless Laboratory,
University College of Science,
Calcutta, Feb 21.

Magnetic Behaviour of Organic Crystals.

THE interesting observations of Sir William Bragg on the deportment of crystals of naphthalene in a magnetic field (NATURE, Supplement, May 7, 1927) have been followed up quantitatively in this laboratory, and some very significant results have been obtained. It is found that the diamagnetic anisotropy of naphthalene is extremely pronounced, the susceptibilities along the three magnetic axes of the crystal being approximately in the ratios 16 · 7 . 4. That such a high degree of anisotropy is to be expected in aromatic compounds is indicated by the data for magnetic birefringence in liquids, as had indeed been shown earlier (C V Raman and K S Krishnan, *Proc Roy. Soc.*, A, vol. 113, p 511, 1927). Mr. S Bhagavantam, who made the measurements, finds that the axes of maximum diamagnetic susceptibility and of minimum optical dielectric constant in naphthalene crystals are approximately coincident This observation explains why organic liquids derived from naphthalene, and indeed also aromatic liquids generally, exhibit a strong *positive* magnetic birefringence. We may further expect to find that in aromatic compounds generally, the magnetic and optical characters are linked together more or less in the same way as in naphthalene crystals.

The magnetic behaviour of organic crystals of the aliphatic group of compounds is different. Not only is the anisotropy, in general, less pronounced, but also the relation between the magnetic and optical characters is more varied. In some crystals, for example, iodoform, Mr Bhagavantam finds the axes of maximum magnetic susceptibility and optical dielectric constant are parallel, while in others, for example, urea, they are crossed These facts have a bearing on the explanation of the fact that liquids of the aliphatic class exhibit a magnetic birefringence which is usually much feebler than in aromatic liquids, and further that in some of them the magnetic birefringence is positive and in others negative An extended series of measurements of magnetic birefringence in liquids of the aliphatic class is now being made by Mr Ramanadham here, and is serving to elucidate the relationships between the optical and magnetic characters of organic compounds and their dependence on chemical constitution

Since the position of the magnetic axes of a crystal depends on the orientation of the molecules in the unit cell of the lattice, it is clear that the studies of magnetic behaviour of organic compounds will form a powerful auxiliary to X-rays in the analysis of their crystal structure.

C. V. RAMAN.
210 Bowbazar Street,
Calcutta, India, Mar. 7.

Effect of X-rays on Seeds.

The effect of X-rays on growth and development is a subject which has always caused considerable interest. It can be studied most easily in plants where cell division takes place so rapidly that daily growth can be observed.

We irradiated various kinds of seeds, chiefly broad beans, barley, and mustard, the effects on these forms being dissimilar although the conditions and the dosage were exactly alike. It would appear, therefore, that a specific dose is required. We used approximately three times the dose of X-rays which would cause the human skin to redden, at 120 kilovolts. In every case the seeds were covered with black paper to protect them as much as possible from the light and heat from the tube.

The broad beans gave the most rapid and striking results. Seeds which had been planted for different lengths of time, varying from one week to a few hours, and also dry seeds, were employed, an equal number of seeds in each case being used as controls. Stunting followed irradiation in all those which had been growing for more than 24 hours. The changes were not observable for some days (two or three) and were first seen in the oldest seeds, but beans which had been growing for 48 to 72 hours appeared to be most sensitive. In addition to being stunted the roots appeared to become slightly bulbous at the tip. In most cases the shoots appeared later than in the controls, but sometimes failed altogether. Side roots never appeared in the stunted X-rayed specimens.

In mustard seedlings the only detrimental result was the failure of the side roots to develop, and that only in the seeds which had been growing for more than 72 hours before they were irradiated. An extremely small dose (about $\frac{1}{20}$ of above) appeared to cause more rapid growth.

Little alteration was found in the roots of the barley, as in this plant the shoots were most radiosensitive and showed very much less growth than the controls.

Ruth E P. Patten.
Sylvia B. Wigoder.

The Department of Zoology,
Trinity College, Dublin,
Mar. 11.

Local Extinction of a Recently Abundant Lamellibranch.

The Lamellibranch *Spisula subtruncata* (Da Costa) is reported in various old records as occurring abundantly in parts of the Clyde Sea Area For example, in "The Mollusca of the Firth of Clyde," 1878, p. 33, A. Brown writes: "Exceedingly abundant a little above low water in Ettrick and St. Ninian's Bays, Bute; and in Fintry Bay, Cumbrae. It is common also all along the Ayrshire coast, and in most sandy bays throughout the district. In Cumbrae they are known as 'Aikens,' and are used both for food and bait." Further confirmation is found in the *Medusa* records and in the fauna and flora published for the British Association in 1901—records of almost thirty years age and older

By contrast with these records of abundance one of us (R. E.) cannot recall ever having seen a living *S. subtruncata* in the course of twenty years In recent years we have made a very careful search for this species in Cumbrae, Bute, and the Ayrshire coast, etc., without finding a single living specimen, although the shells occur in millions in Kames Bay, St. Ninian's Bay, and Hunterston sands.

Further, inquiries amongst fishermen reveal the facts that old men (70-80 years) immediately recognise *S. subtruncata* as 'Aikens,' and assert that they knew them and used them in youth and middle life, but "have not seen a single full one for thirty years or more." Similar evidence is got from younger men, until we reach men of 45 or so, who say they have never seen or used them although their fathers did

In short, there is good evidence that *S subtruncata* died out in this district about thirty-five to forty years ago. Type samples of the dead shells have been sent to the Royal Scottish and British Museums and the Fisheries Laboratory at Lowestoft

Richard Elmhirst
A. C Stephen

Marine Station,
Millport.

Successive α-Transformations

It is well known that, in such parts of the radioactive transformation series as are not disturbed by β-emissions, the successive α-particles are shot out with ever-increasing energy. The paradox that, although the probability of emission increases so enormously with the energy, it is the slowest particles that first come out, has once again come to the fore now that wave mechanics has led to a theoretical connexion between energy and decay-period It seems worth while to point out that this difficulty can be very simply explained if we assume that all the α-particles in question are originally in the same quantum state. For if N interacting particles have the total energy NE they will not each fly away with the energy E; it will depend on the nature of the forces acting between them whether the first ones take more than their share or less.

A simple example is provided by the helium atom, the removal of one electron involves binding the other closer, and the remaining electron has less energy than it had before the removal. If a helium atom is placed in an electrical field it has, according to wave mechanics, an intrinsic probability that it will become ionised (Oppenheimer, *Phys Rev.*, **31**, p. 66, 1928), and owing to the above energy relation the second ionisation will take place more slowly than the first. In the helium atom we have the case that the particles in question, at the distances in question, repel each other, in a radioactive nucleus we have the opposite case. For by hypothesis the particles here are so close to one another that their attractions outweigh their repulsions; it follows at once that the first particle is the most difficult to remove.

G. Gamow.

Institute for Theoretical Physics,
Copenhagen.

Astrophysical Estimate of Ionisation Potential of Vanadium.

In a previous letter (Nature, June 9, 1928) I outlined the method by which estimates of ionisation potentials might be derived from the spectra of Cepheid variables. Many of the lines emitted by ionised atoms are intensified at or near maximum luminosity phase and diminish in intensity as the star passes through the phase of minimum light Many arc lines, on the other hand, show the reverse tendency. By comparing the behaviour of certain ionised lines with spark lines due to titanium, scandium, strontium, and barium, the ionisation potentials of which are known, it has been possible to estimate this constant for iron, yttrium, and lanthanum (loc. cit.), and quite recently for vanadium. From the periodic changes in intensity of the ionised line λ4205·07 I have obtained for the *ionisation potential of vanadium* 6·74 *volts*, the final figure being extremely uncertain.

In a recent letter from Dr. W. F. Meggers, Bureau of

Standards, Washington, I am reminded that Prof. H. N. Russell (*Ap. J.*, 66; 1927) has obtained the principal ionisation potential of vanadium from spectral series relations to be 6·76 volts. I am unaware of any laboratory determination of this quantity, but the close agreement between the spectroscopic and the present astrophysical determination is very satisfactory.

As before, I am under obligations to the Director of the Dominion Observatory, Ottawa, for the loan of the spectrograms from which my microphotometer graphs have been made A. VIBERT DOUGLAS.

McGill University,
Montreal, Feb 28.

Raman Effect and Fluorescence.

SIMPLE probability considerations reveal an interesting relation between fluorescence and the modified scattering of light. If N_r, N_s, etc , be the number of systems in the energy levels of energy values E_r, E_s, etc., the induced probability of transition $E_s \longrightarrow E_r$ may be denoted by W_{sr} If $E_s > E_r$, this causes the emission of a quantum $h\nu_{sr} = E_s - E_r$, which fuses into an external quantum $h\nu$, so as to form a new quantum $h(\nu + \nu_{sr})$, giving rise to negative or anti-Stokes lines. The total energy so radiated is $N_s \,.\, W_{sr} \; h(\nu + \nu_{sr})$

Similarly, the transition $E_r \longrightarrow E_s$ gives rise to the positive lines of frequency $\nu - \nu_{sr}$, and its total energy is $N_r \,.\, W_{rs} \,.\, h(\nu - \nu_{sr})$. As a result, the s^{th} level acquires a surplus number $(N_r - N_s)W_{rs}$ systems $(W_{rs} = W_{sr})$. We postulate that thermal agitation restores the normal distribution so that this surplus number reverts to the r^{th} level, emitting total energy $(N_r - N_s)W_{rs} \,.\, h\nu_{rs}$, of frequency ν_{rs}. We identify this radiation with fluorescence Of course it is in the infra-red, when the modified lines are visible. When ν_{rs} nearly equals ν, it will be shown with the help of Born's formulæ, in a paper appearing elsewhere, that the factor W_{rs}, since it involves a term $1/(\nu^2 - \nu_{rs}^2)$, becomes very large, so that the intensity of a fluorescent line (now visible) is much greater than a modified visible line, as is actually the case

PAUCHANON DAS.

72 Srigopal Mallick Lane,
Calcutta, India, Feb. 28.

Indication of Hydroxyl in a Water Vapour Discharge Tube.

THE presence of OH in the gas coming from a water vapour discharge tube has been demonstrated by photographing the exit tube with a quartz spectrograph , the well-known band at 3060 A was obtained. Addition of a small quantity of oxygen to the water vapour has the effect of increasing the intensity of the bands , a larger amount of oxygen causes the appearance of the green oxygen afterglow. This glow is continuous in the visible and is accompanied by the OH bands in the ultra-violet. The active gas appears to possess both reducing and oxidising properties. This is illustrated by the simultaneous reduction of copper sulphate to copper oxide and metallic copper and the oxidation of metallic silver. In both instances heat effects have been observed. The glow appears to be unaffected by the copper sulphate, but is removed by the silver. An extensive study of the conditions determining the production of OH, its separation from any other active constituents which may be present, and its chemical properties are now under way in this laboratory.

G. I LAVIN
FRANCIS B STEWART

Princeton, New Jersey, Mar. 15.

The Green Flash.

HERE at 700 feet above the sea the green flash at sunset may be seen whenever the horizon is clear of clouds. At times the air is so clear that the mountains of St Vincent, 110 miles to the west, can be clearly seen at about the time of sunset. On such evenings Venus may be followed right down to the sea horizon when, as now, it is near its maximum brightness.

A few nights ago I watched the planet setting through a pair of field binoculars. About five minutes or so before it set there was a great deal of change of colour from red to peacock green, but it was quite evident that the red colour was on the whole below and the green above, showing that the image of Venus was being drawn out into a short spectrum. When the planet was very nearly on the horizon the colour changed several times from red to green and vice versa, but just as it disappeared the image was of a distinct peacock green.

This observation shows that the explanation of the green ray is physical (refraction) as now generally admitted, and not physiological, for the light from Venus was not nearly intense enough to produce an after-image C. J. P CAVE.

St. Nicholas Abbey,
Barbados, Mar. 12.

African Pluvial Periods.

THE interesting remarks in the News and Views columns of NATURE for Mar. 16, with reference to Bushveld man and Mr Leakey's discoveries in Kenya, direct attention once again to the 'Pluvial periods of Eastern Central Africa' I should like to be permitted to point out that while the theory which finds reason for a genetic connexion between these 'pluviations' and glacial episodes of higher latitudes is sound enough, and although there is evidence to show that in all probability some such connexion existed, the correlation of Kenya pluvials with definite periods of the Pleistocene, as recently set forth, is purely hypothetical. There is room for discussion concerning them , and according to my showing, which may of course be wrong, the Kenya archæological expedition's third 'pluvial' is, so to say, an epi-pluvial, and is (if anything) Buhl and not Wurm in date , and so *mutatis mutandis* with the others The Expedition's ground in the Rift Valley is likely to be full of pitfalls, and in my opinion a great deal of work must be done there before one can say with confidence which of certain deposits are pluvial and which are not. E J. WAYLAND.

Beryllium and Helium.

IN a letter on the "Transmutation of the Lighter Elements in Stars" (NATURE, April 13, p. 567), R. d'E. Atkinson and F. G Houtermans remark that "the isotope Be^8 . . is probably unstable (it does not occur on the earth) and will then almost certainly break up into two helium-nuclei . . "

I am reminded of an observation made many years ago. It was found (*Proc. Roy. Soc.*, A, vol 80, p. 587 ; 1908) that specimens of the mineral beryl always contained helium without appreciable quantities of radioactive matter to explain its presence.

Can it be that this helium has originated from the isotope Be^8 ? If so, it would indicate that the isotope in question, even if it does not exist now, *has* existed within geological times, and subsequent to the formation of the mineral. RAYLEIGH

Terling Place, Chelmsford,
April 14.

Geological Aspects of the Channel Tunnel Scheme.

By JOHN PRINGLE

THE numerous advantages that will result from the making of a tunnel between England and France have long been recognised, but it may not be generally known that in support of such a scheme legislation dealing with the preliminary procedure passed both the French and British Parliaments so long ago as 1875. Less than five years later a start was actually made and headings were commenced on both sides of the Channel, but the failure of the French Channel Company, followed by an order issued by the British Government to close down the work of the British engineers, brought the project to a standstill Now that the scheme has been revived it is hoped that the undertaking will be pushed through to a successful issue Geologists agree that the excavation of the tunnel is practicable, and no obstacles which will defeat the ingenuity of engineers are likely to arise in the course of its construction

During the years that have elapsed since the heading was stopped at Dover, much has been learned concerning the deep-seated geology of East Kent and of the opposite shore of France, and some of the results obtained may not be without interest at the present juncture

It seems scarcely necessary here to relate the views held by early geological observers concerning the physical identity of the coalfields of Somerset with those of the north of France, and the continuity of the higher formations in both countries, nor does it seem needful to do more than merely mention that the theories advanced in 1855 by Godwin-Austen, in a remarkable paper "On the Possible Extension of the Coal Measures beneath the South-Eastern part of England," gave rise to considerable interest in the problems connected with deep-seated geological structures It is sufficient to say that most geologists were so certain of the occurrence of Coal Measures under Kent that Prestwich in 1873 maintained that these old rocks would be found sufficiently near the surface at Dover to allow submarine tunnelling Picturesque accounts of the excavations of a tunnel by working the coal made their way into the columns of the newspapers When the boring made alongside the Channel Tunnel shaft at Shakespeare Cliff proved the presence of Upper Carboniferous Rocks with seams of coal, a great impetus was given to further exploration by the boring-tool, and since 1886 more than forty borings and shafts have been carried down to the Palæozoic rocks in East Kent

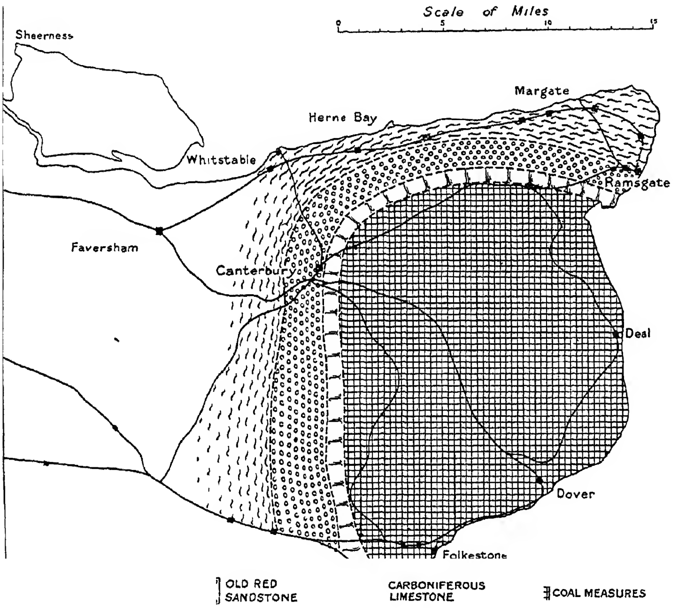

FIG 1 —Sketch map of the Palæozoic strata proved at depths varying from 900 ft to 1400 ft below Ordnance Datum in East Kent

The information obtained by many of the companies carrying out these explorations was, however, jealously guarded for commercial reasons, and had it not been necessary to seek the advice of geologists, perhaps few details of the borings would have become public knowledge Fortunately, the advice of the officials of the Geological Survey was sought, and they were permitted to examine the cores of nearly all the boreholes The excellent use made of these opportunities resulted, when publication was allowed, in contributions to geological science of the highest value These borings have demonstrated that Kent, instead of being an area of simple geological structure, as was thought, is one of considerable complexity, and more geological formations have been proved underground in that county than in any other in England

As an outcome of the work of the Geological Survey, it is now possible to map the Palæozoic platform, and to show the area occupied by the Silurian, Old Red Sandstone, and Carboniferous rocks (Fig 1) Further, a plan can also be made of the disposition of the Jurassic rocks on the Palæozoic floor and the general arrangement they would present, if all the strata down to the base of the Wealden were removed (Fig 2). Fig. 2 is based on that published by the Geological Survey, but certain modifications of the outcrops of the

formations have been made by me to incorporate later information. All of these formations are buried beneath a great thickness of Cretaceous and Tertiary deposits, some of which are depicted on Fig 3, and the great anticline of the Weald has been shown to be a purely superficial structure superimposed on an underlying syncline.

In Northern France borings have also been made since the heading was driven at Sangatte near Blanc Nez. Here the Cretaceous rocks are nearly identical with those of Kent, but the Wealden anticline, which is prolonged into France, has been denuded down nearly to the oldest Jurassic strata. These occupy the low-lying tract known as the Boulonnais, and they are surrounded by chalk hills. In places, inside the ring of chalk, Palæozoic rocks are exposed at the surface, and this fact gave rise to the idea that a Channel tunnel might be excavated throughout in the older strata. At Dover, however, the discovery of Coal Measures at the depth of 1158 ft below Ordnance Datum showed such a scheme to be impracticable, quite apart from other difficulties arising from the heavily watered Hastings Sands and Inferior Oolite.

The most important formations to be considered in the making of this tunnel are the Gault and the Lower Chalk. The lithological similarity of these rock-groups as exposed in the cliffs of Kent and in the bold headland of Blanc Nez is so close as to make it certain that no important change in mineral characters takes place in the beds immediately underlying the floor of the Channel. For example, the thickness of the Lower Chalk remains practically constant: in Kent it is 193 ft, at Blanc Nez, 189 ft. The work on the Channel Tunnel can thus be carried out with the advantage that identical strata are to be penetrated at each end.

The chief and, one might say, the only engineering difficulty likely to be encountered in constructing a tunnel in the Chalk would arise from the presence of water, and regarding the question of the amount and distribution of water in this formation many useful data have been obtained from the borings, shafts, and other works made in Kent and in northern France during the past forty years. The knowledge may be summarised as follows: in the Upper Chalk there is a great amount of water, in the Middle Chalk and perhaps in the higher part of the Lower Chalk there is a smaller quantity, but in the remaining portion of this lowest subdivision, the Grey Chalk and Chalk Marl of older writers, except in fissures, little or no water is found, in consequence of the increased amount of argillaceous sediment in this part of the series. Thus, the lower part of the Lower Chalk, which has generally been considered the most advantageous position in which to drive the tunnel, is favoured by all recent experience as the driest and most homogeneous part of the Chalk for this purpose.

At the same time, the relative dryness of the Lower Chalk does not preclude the possibility of meeting water in some quantity in that subdivision. The Chalk, like most other formations, has been subjected to pressure and folding, giving rise to faults and fissures. These have a west-north-westerly trend in Kent, and a similar direction has been noted in France. They allow the passage of a considerable volume of water, even in the Lower Chalk. Thus, for example, a strong spring is given off from a fissure in the Lower Chalk at Lydden Spout, west of Shakespeare Cliff.

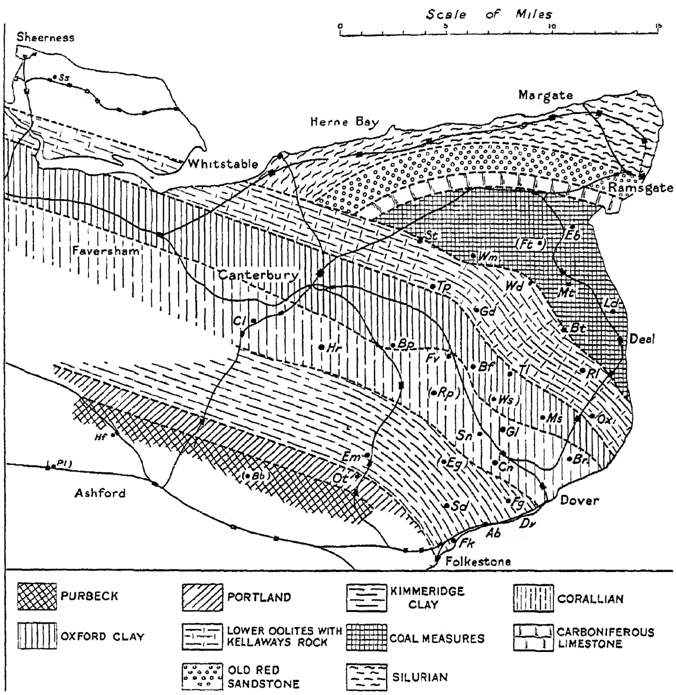

FIG 2.—Sketch map showing the disposition of the Jurassic strata on the Palæozoic floor in East Kent. Boring sites shown thus. Dv, etc.

Obviously, therefore, much will depend on the relation of the tunnel to the trend of the fissures. Where the headings run parallel with the fissures little or no water need be expected. This was clearly demonstrated by the experience gained in driving the headings at Dover and at Sangatte on the French side of the Channel. At Dover a heading 7 ft. in diameter was driven for a distance of more than 2000 yards, in a direction approxi-

mately parallel to the lines of faults and fissures A small amount of sea-water made its way into the workings, but a hand-pump was found sufficient for dealing with the flow, the water caused no inconvenience, and was easily kept out by a ring of tubing After an interval of nearly thirty years the heading was reported to be dry in 1912 On the French side, however, the engineers experienced much trouble in dealing with the water coming from a fault in the lower part of the shaft, and in a length of the heading driven nearly at right angles to the fissures a fair amount of water was also tapped

The excavation of the lower part of the Lower Chalk is therefore not likely to be entirely free from water-troubles The difficulties, in fact, may be increased if the original plans for the drainage of the tunnel are carried out It may be remembered that it was proposed to drive a heading with an inclination of 1 in 80 down-hill from the shore at each side for a distance of two miles, and then to continue the excavations with a rising gradient of about 1 in 2000 to the centre of the Channel This would probably mean that part of the tunnel situated under the sea would lie within the Middle Chalk, and would, therefore, cross the fissures at a rather low angle in strata known to allow the passage of water in increased quantities This difficulty might perhaps be overcome by driving the tunnel at each end into a lower geological formation, namely, the Gault Clay. This is a point worthy of serious consideration by the engineers If this plan were followed, the highest point at the centre of the tunnel would probably lie within the drier Lower Chalk.

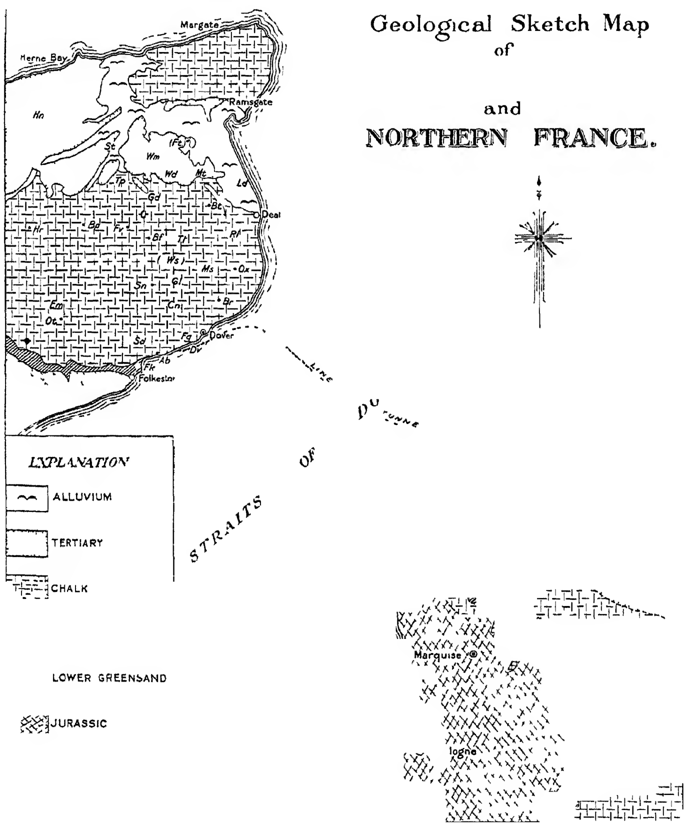

FIG 3

It is probable that in earlier discussions the Gault formation was given less consideration in the belief that it was overlain by water-bearing Upper Greensand; in fact the majority of existing plans show a narrow stippled band between the Gault and the Lower Chalk to represent a supposed outcrop of Upper Greensand. Now it has been clearly shown as a result of palæontological investigation that the clay-beds IX to XIII of later classifications of the Gault at Folkestone, and their equivalents at the south end of Blanc Nez, represent in argillaceous facies the sandy beds of the Upper Greensand of the west of England Consequently, if the headings at Dover and Blanc Nez were to be driven in the Gault at about the horizon of Bed IX, the workings would lie in argillaceous beds, and the risk of meeting a considerable volume of water would in this way be greatly reduced

As a final remark, it may be suggested that precautionary measures should be taken by the engineers against the possibility of meeting drift-infilled valleys in the Chalk underneath the Straits of Dover. The geological chart showing the outcrops of the subdivisions of the Cretaceous rocks on the floor of the Channel, which was made by MM Potier and A de Lapparent as a result of more than 7000 soundings, certainly does not reveal any trace of former valleys in this region, nor has any recent evidence of their existence been obtained, but the fact that many such infilled valleys in the eastern counties of England have been shown to reach depths of more than 300 feet below Ordnance Datum emphasises the need for caution, since such a valley would probably carry a considerable body of water

Work of the Medical Research Council [1]

THE report of the Medical Research Council for the year 1927–28 again indicates the wide range of the researches initiated or helped by the Council As in previous years, the work carried out has been aided by grants from various public bodies, including the Dental Board of the United Kingdom, the Miners' Welfare Fund, the Empire Marketing Board, the British Empire Cancer Campaign, and the Distemper Research Council of the *Field* newspaper, as well as by private benefactions At the same time the economy and efficiency with which the available funds are expended are greatly increased by the facilities of the university and other laboratories which are placed at the disposal of workers receiving salaries or grants-in-aid Of the Parliamentary grant of £148,000, 6 per cent only was absorbed by administrative expenses, £52,000 was provided for the National Institute for Medical Research at Hampstead and the associated farm laboratories at Mill Hill, whilst £86,500, with £18,000 from private and public benefactions, was absorbed by research grants in various university and other centres in Great Britain and by the investigations of the Industrial Fatigue Research Board

Sir Archibald Garrod and Prof Dreyer retired by rotation, and their places were filled by Sir John H Parsons and Dr Robert Muir Sir Hugh Anderson died after the close of the year covered by the report, and the vacancy was filled by the appointment of Prof Leathes Dr H H Dale has been appointed director-in-chief of the National Institute for Medical Research

VIRUS DISEASES

Work has been continued on the filter-passing viruses and their relation to cancer, and on the treatment of this disease Gye has continued his work on the fowl tumour, in part in association with J. H Mueller of the Harvard Cancer Commission, both in Great Britain and in the United States The original experiments indicated that the cell-free filtrate by which the growth can be transmitted contains a self-propagating virus and a chemical factor the virus could be destroyed by chloroform or acriflavine in serum, whilst the chemical factor disappeared on keeping or warming the filtrate Unfortunately, more recent experiments have failed to give consistent results, treatment of the filtrate either destroying both virus and chemical factor, or failing to destroy the former the inconsistency is presumably caused by the difficulty of obtaining filtrates with uniform properties The disappearance of potency in the filtrate on incubation is due to the presence of an oxidising ferment it can be checked by the addition of hydrocyanic acid, cystein, or reduced glutathione Gye has also found that the filter-passing organism of pleuropneumonia of cattle is destroyed by acriflavine and that the antiseptic's action is aided by the addition of serum, which has an inherent destructive action upon the virus

During the past seven years the outlook for the radium treatment of cancer has been quite transformed definite technical methods have now been worked out for almost every region of the body except the stomach It is already possible to say that early cancer of the neck of the womb can be removed by a course of radium treatment as surely as by the knife, and of course with less suffering and risk. Radium is also the best means of treating 'inoperable' cancer of the mouth or tongue, and will probably soon replace excision for the early cases, since it removes the growth without mutilation and with less scarring, and gives a good functional result It seems probable that similar advances will be made in the treatment of cancer in other regions of the body Advance in the use of radium will become more rapid as confidence in its efficacy in the treatment of early cases is gained, as the supply of radium is increased and as the realisation that every treatment centre must be a research centre also and vice versa is generally accepted The report states that the time has now arrived when radium treatment must be put within the reach of all whose lives depend upon it, but this requires a greatly increased supply of radium and an increase in the number of skilled operators and beds available

Work has been continued upon cell growth with the view of elucidating further the nature of tumours and the effects of various agents upon them J. A Andrews found that growth *in vitro* of both normal embryonic and malignant tissue is associated with an increase in the hydrogen ion concentration of the medium, and that both tissues *in vitro* are acid in relation to normal adult tissue It might be suggested tentatively that the incidence of malignant disease depends upon the presence of an optimum hydrogen ion concentration coinciding with an autolysate resulting from focal cell death, which acts as the growth-promoting agent Helen Chambers, in investigations on the effects of tumour products upon tumour growth, has shown that if the tumour is excised three or four days after irradiation with a lethal dose of the X-ray *in vivo*, the animal has absorbed something which confers protection, although the blood contains no immunising power for another animal, and a cell-free extract of the excised tumour cannot confer immunity It appears that the antigen producing immunity is absorbed in minute quantities over a period of several days, so that its isolation in concentrated solution is difficult

J R Perdrau has studied that form of encephalomyelitis which is occasionally, though very rarely, associated with vaccinia, as in the ordinary vaccination against smallpox This type appears to be quite distinct from encephalitis lethargica (sleepy sickness) and from poliomyelitis (infantile paralysis), but is identical with that associated with certain

[1] Committee of the Privy Council for Medical Research Report of the Medical Research Council for the year 1927–28 (London H M Stationery Office, 1929) 3s net

acute infections such as measles or smallpox, and with results, also rare, found after antirabic inoculations by Pasteur's method Hence the rare post-vaccinal encephalitis is not directly due to the vaccinia virus.

The work on canine distemper, already referred to in these columns, by P P Laidlaw and G W Dunkin, has reached the stage of practical application, and numbers of dogs have been inoculated against the disease · 73 animals from various packs of foxhounds and 300 dogs of other breeds have been inoculated, but only one contracted the disease in a mild form, although most were exposed to infection Of 170 uninoculated foxhounds which caught the disease, 74 died

The investigations on virus diseases have had another application in quite a different direction Yellow fever is now known to be a virus disease Hindle, adapting the methods devised by Laidlaw and his colleagues, succeeded in protecting monkeys against the disease, and the method has already been used in stamping out a local epidemic in Brazil Such a result justifies fully the experimental investigations on canine distemper, quite apart from any practical benefits gained for the dog.

Artificial Light Therapy.

Some carefully controlled experiments on treatment by artificial light have been carried out by Dora Colebrook on school children No beneficial results were observed light had no influence on gain in weight, height, or 'spirits,' and the incidence of 'colds' was slightly higher among those receiving the treatment The report critically reviews the results of light therapy, and concludes that its sole justifications are in the treatment of rickets and chronic infections such as tuberculosis and, by local application, in cases of corneal ulcer or lupus, and possibly varicose ulcers. Irradiation of the skin produces vitamin D, from the ergosterol present, and increases the bactericidal power in shed blood; but this increased power has not been correlated with any permanent effects of value to the body, and in any case is quickly followed by a decrease, and the bactericidal power may actually fall below the normal level Moreover, exactly similar effects can be produced by other skin irritants such as a mustard plaster In the case of rickets, the administration of vitamin D by mouth has exactly the same effect as irradiation of the skin by ultra-violet light; and since the vitamin can now be prepared synthetically by irradiation of ergosterol and administered in highly concentrated solution, there appears no reason to use artificial light to supply what can be given in the food or as a medicament, especially as the method of oral administration is very much cheaper and more generally available.

Sunlight therapy in surgical tuberculosis is undoubtedly very beneficial, but this treatment includes exposure to the open air and also to the longer light and heat rays of the sun, and cannot be strictly compared with a treatment indoors from a source of ultra-violet rays It appears urgent that light clinics should carry out carefully controlled trials of the effects of exposure in the treatment of various conditions

The volume of work on the vitamins carried out during the past year will be separately reviewed later in these columns

Tuberculin Test

The method of detecting tuberculosis in cattle has been improved The 'subcutaneous' tuberculin test has been found to be inconvenient, often fallacious, and always difficult to interpret The 'double intradermal' test is simple and convenient, trustworthy and unambiguous, and has now been generally adopted As a by-product of this work, G W Dunkin has devised a diagnostic agent for Johne's disease of cattle, a slow wasting disease leading to emaciation, loss of milk, and finally death There is no known cure and no effective means of control except early detection and removal of infected animals The test can be made concurrently with the tuberculin test and has revealed the great prevalence of the disease among stocks in Great Britain its chief danger is in the diminution of the milk supply which results from infection By early diagnosis infected animals can be removed and fattened for killing, and herds kept free from the disease The Council points out that, apart from its indirect hygienic value, this work will save to the agricultural community, in the future, more in a year than has been expended on all forms of medical research supported by the Council during all the years of its work from the beginning.

Epidemiology.

In investigations on experimental epidemiology carried out on a mouse population kept under continuous observation for eight years, W W C Topley and M Greenwood have found that in each epidemic period the expectation of life of the survivors has been more closely correlated with the length of previous exposure to risk than with the severity of that risk as judged by the average death-rate. This suggests that the active immunisation from non-fatal infection is a more important factor in increasing the average resistance of survivors than the elimination, by death, of susceptible animals It has also been found that pasteurellosis, an infection primarily of the respiratory tract, and mouse typhoid, a typical intestinal infection, show a definite difference in their epidemiological behaviours, which may be of great significance

L. Hill and his colleagues have found that spraying hypochlorite solution into the air of a room or circulating the air through oiled baffleplate filters definitely diminishes the number of microbes present the experiments provide justification for the use of sprays in crowded public rooms.

H Burt-White has found that there is a close correlation between a positive Dick test and subsequent puerperal sepsis in pregnant women. The test is used to indicate susceptibility to scarlet fever, but also indicates susceptibility to the toxins of other strains of streptococci, including those from puerperal fever Arrangements have been made

to carry out an extensive trial of the results of rendering Dick positive subjects immune to puerperal fever before labour.

BIOLOGICAL STANDARDS.

In concluding this review of some of the important subjects dealt with in this report, reference may be made to the work on biological standards, which has an international importance The first British standard tuberculin has been adopted as the international standard by the Permanent International Standards Commission of the League of Nations Health Organisation its strength is equivalent to that of the standard originally created by Ehrlich. The adoption of an international standard of dried scarlatina antitoxin necessitated the production of an equivalent British standard: but the method of measuring the potency of an antitoxic serum by its neutralising action on the toxin, as tested by the human skin reaction, cannot discriminate between antitoxins differing from each other by less than 100 per cent Recently, Hartley has succeeded in concentrating the toxin so that its lethal dose for the rabbit can be accurately measured and an adequate number of lethal doses used in the neutralisation test A British standard digitalis powder is in course of preparation and will be made to conform with the international standard already in existence An international physical unit of X-ray dosage has also been defined and adopted and agreement reached on the principles governing its standardisation the connexion between physical dosage and biological effect is still being studied

Obituary.

DR T. B OSBORNE.

THOMAS BURR OSBORNE, who died on Jan 29, was the last of the small band of pioneers who laid the foundation-stones of modern protein chemistry Born in New Haven, Connecticut, on Aug. 5, 1859, of old New England stock, he graduated after the usual course in arts at Yale College in 1881. Turning his attention to analytical chemistry, he took the degree of Ph D in 1885, and a year later joined the staff of the Connecticut Agricultural Experiment Station in New Haven Prof Samuel W Johnson, director of the Station and professor of agricultural chemistry at Yale, suggested that Osborne should extend Ritthausen's early work on vegetable proteins, and in 1888 he started investigations which continued without interruption until his retirement in 1928

From 1890 until 1901 Osborne's chief interest was in the preparation of pure specimens of the seed proteins, and his initial investigation of the oat kernel, published in 1891, was the forerunner of a series of papers in which the proteins of thirty-two different seeds were described These researches demonstrated that proteins could be regarded as definite chemical individuals, and that many substances formerly grouped together under such terms as 'legumin,' 'conglutin,' and 'vitellin' differed in chemical composition as well as in physical properties His conception of the protein molecule as a definite chemical entity was strengthened by his work on the acid-binding power of edestin, published in 1899, and by later papers in which it was shown that proteins in general could form salts with both acids and bases, and that they were capable of electrolytic dissociation

Working as he did in close contact with agriculture, Osborne early realised the need of a chemical characterisation of proteins which would give some index of nutritive value, but characteristically deferred any such research until he was convinced that he could first obtain proteins in the highest state of purity Taking full advantage of the developments in analysis due to Kossel and Fischer, he commenced in 1906 a series of protein analyses which demonstrated that wide differences existed in the amino-acid composition of many proteins of economic importance These analyses were made with Osborne's usual extreme care, and were the basis of his future work on the nutritive value of the proteins, begun in collaboration with Prof Lafayette B Mendel of Yale, in 1909, and continued with the generous support of the Carnegie Institution of Washington until the time of his death

The results of Osborne's protein investigations were summarised in a monograph, "The Vegetable Proteins," which was published in 1909, and extensively revised in 1924 His life was devoted almost entirely to his research, and, unlike most investigations, increasing years and fame brought no increase in administrative responsibility, consequently until the last his working hours were spent in the laboratory, and those who were privileged to work with him and gain his confidence found in him not only a genial friend and stimulating critic, but also a man with an unsurpassed wealth of practical experience in his own particular field of science

Osborne was a member of the National Academy of Sciences, an honorary Sc D of Yale, and an honorary fellow of the London Chemical Society. Last year the American Association of Cereal Chemists instituted the periodic award of the Thomas Burr Osborne medal for distinguished research in cereal chemistry, and he was himself the first recipient

WE regret to announce the following deaths:

Dr. Paul Dvorkovitz, a well-known petroleum technologist, aged seventy-two years.

His Highness Sir Bhawani Singh Bahadur, K.C S I, Maharaj-Rana of Jhalawar, who was well known in scientific circles in Great Britain and was a delegate from India at the two hundred and fiftieth anniversary of the Royal Society, on April 13, aged fifty-four years

Prof. John MacCunn, emeritus professor of philosophy in the University of Liverpool, on Mar. 24, aged eighty-two years

News and Views.

Prof. D'Arcy Thompson's presidential address to the Classical Association on April 8 at Cardiff is a welcome reinforcement of the plea so often advanced in these pages for a closer alliance between the humanities and science. It is the more welcome because it approaches the subject at an unaccustomed angle and in a fresh spirit of hopefulness and enjoyment. Whereas we are always thinking, and have often said, how necessary is some knowledge of history to the man of science and some knowledge of science to the historian and man of letters, and how deplorable is the general lack, Prof Thompson boldly takes the cheerful line. "From time immemorial science and the humanities have gone hand in hand. Aristotle wrote on poetry and Plato loved astronomy And at the Renaissance all the scholars read Galen and Hippocrates." It was the natural thing, and, though the vast extension and specialisation of knowledge now make it more difficult, it is still the most stimulating and pleasurable way to widen and deepen our intellectual associations It is, of course, all that, on the side of personal culture, and far more on the side of civilised life and social continuity. Nothing is more important for the future, if mankind is to rise above the pleasures, the problems, and the whirl of the present, than to go back and find the roots of our thought, the first impressions of the wonder and order of the world, in the works of the earliest thinkers who have expressed them for us Socially and philosophically, this sense of filiation and indebtedness is even more valuable than the idea of solidarity with those now living which is now constantly dinned into our ears by the multitude of international associations, from the League of Nations downwards

In spite of his cheerful tone, one must sorrowfully admit that Prof D'Arcy Thompson is one of a very small band of persons now alive qualified to act as liaison officers between the two camps of science and humanity Scholar and naturalist, he has written a glossary to the 'Birds' of Aristophanes, of which he spoke at Cardiff with such well-merited enthusiasm. Prof. Arthur Platt was another, approaching the matter with the outlook of the Greek scholar. The essay which occurs to us as most in sympathy with Prof. D'Arcy Thompson's address, and worth reading after it, is Platt's chapter on "Aspects of Biological and Geological Knowledge in Antiquity" in "Science and Civilization," the sixth volume in the Unity Series Unfortunately, it was not reprinted in Platt's posthumous Nine Essays, but it is delightful in style and fits in admirably to the sketch which Prof D'Arcy Thompson gave last week. Some day perhaps the Classical Association will form a subsection for the study of classical science

Every year marks a further advance in the steady progress of civil and military aviation. In great measure this is due to the fact that, almost alone in the field of applied science, research and practice in this case can run hand in hand. While the expenditure on air armaments, however, has been bounding up in other parts of the world, the net expenditure of Great Britain for the fourth year in succession, according to the Air Minister in introducing his estimates for 1929, shows a decrease, this in spite of the ease with which it has been demonstrated how vulnerable England is to attack from the air At the end of the year the strength of the Air Force will have been raised from 75 to 82 squadrons, a figure considerably below that of several other great powers. On the civil side, this year will mark a notable stage in the development of imperial air communications. A regular air service to India has already begun, the first outward journey being completed within 150 minutes of the scheduled time, and the return journey almost exactly on time. It is intended to run a weekly service, doing the journey in from six to seven days. Meanwhile steps have already been taken for the inauguration of the other great trunk line service—London to the Cape For some years past, units of the British and South African Air Forces have been making service flights over the routes and collecting data, while particularly during the last twelve months much pioneer work has been done by Sir Alan Cobham, Lady Heath, Lady Bailey, and Captain and Mrs. Bentley. The result has been to provide experience and information without which the regular flight of 6245 miles from north to south would be quite impracticable. Every colony and dominion in South Africa is certain to derive great benefit from this venture. North and South Rhodesia, for example, at present three weeks from London, will come within ten days' journey, and the Union Parliament at Cape Town will be within twelve days of Westminster. The ultimate success of the scheme depends on the financial aid forthcoming from the other Governments concerned

This year's air estimates for Great Britain provide for a number of developments of a technical nature. Two aircraft are to be specially constructed to test the relative merits of monoplane and biplane, particularly for civil aviation. The all-metal plane, which has been the subject of intensive study for some time, is now coming into its own. Four years ago the Air Ministry was ordering one metal machine for every nineteen of wood construction To-day the orders are seven metal machines for one wood, so swift and complete has been the revolution in the methods of construction during the past four years. In introducing his estimates, Sir Samuel Hoare paid a tribute to the brilliant work of the experimental pilots at Farnborough and Martlesham and the special efforts of the Aeronautical Research Committee. Not the least significant of his announcements was his statement of a proposed grant to the recently formed National Flying Services Company, a step, it is hoped, that will stimulate the air sense of the nation. This grant is dependent on the provision, directly or indirectly, of one hundred new aerodromes and landing grounds There can be no doubt that the next few years will witness an enormous speed-up of civil and commercial flying in Great Britain.

AT the meeting of the Royal Meteorological Society on April 17, Dr J. Glasspoole gave some details of the scanty rainfall of the first three months of the year The total precipitation over the British Isles during these months was only half as much as usual and less than that of any similar period in the last sixty years of comparable data. the nearest approach being that of 1891, with 60 per cent of the average amount. The drought of 1929 was most intense in Great Britain in four well-marked areas, each of which received less than one-third of the average. These areas included a narrow strip across the Thames Valley from Gloucester to Margate, Central Wales, the English Lake District, and much of the northern half of Scotland The fall at stations in these regions was as follows .

	Rainfall (in)	Per Cent of Average
London (Camden Square)	1 5	29
Borrowdale (Seathwaite)	9 7	27
Rhayader (Tyrmynydd)	4 2	25
Alness (Ardross Castle)	2 2	22

AT Ardross Castle the period included both the driest January and the driest March of the last sixty years, and the total rainfall was less than that of any other three consecutive months. The total for January to March at Gloucester was only 1 27 in, and at Shoeburyness only 1 18 in Less than 2 in. was recorded at stations in the Midlands, near Oxford and London, and in the neighbourhood of the Moray Firth. There was less than 3 in. during the three months over nearly half the total area of England and Wales, including central and south-eastern districts One of the main features of the weather was the marked weakening of the south-west winds and consequent deficiency of rainfall in the mountainous regions. Parts of the English Lake District and the Western Highlands of Scotland received 25 in. less than usual during this period.

HOLBORN recently acquired an unenviable notoriety in being, on Dec. 20 and 21 last, the scene of a series of street explosions and fires which took place on a line beginning at the junction of Kingsway and High Holborn, and proceeding westwards along High Holborn, Broad Street, and High Street to St Giles's Circus. With commendable promptitude the Home Secretary on Dec. 21 appointed a Commission consisting of Mr R. G. Hetherington, Lieut -Col R A. Thomas, and Mr. E. H Tabor, with Mr. A. S Hutchinson as secretary, to inquire into the circumstances of the explosions and fires , the Commission, which commenced its investigations on the following day, has now issued its Report (H.M Stationery Office, Cmd. 3306, 1*s* 6*d*. net) It is concluded that the explosion occurred in the Post Office tube (an old pneumatic parcels tube now otherwise employed); that it was due to a mixture of coal gas and air , that the gas probably resulted from gradual accumulation, together with an escape sufficient to increase the concentration to the explosion limit , and that the gas became ignited in a manhole through some action (probably the use of a petrol lighter) by a workman.

IN its investigations concerning the nature of the explosive agent, the Commission examined three theories . that the gas was coal gas, petrol vapour, or gas arising from anaerobic fermentation The petrol vapour theory was rejected after elucidation of the facts that no odour of petrol was perceptible. and that there was no black smoke or luminous flame. The theory that the explosion was due to the presence of fermentation gas was carefully studied. Evidence regarding the odour was conflicting , none of the samples of gases collected from the ground after the explosion, however, contained methane and carbon dioxide as the chief constituents, whilst all contained oxygen in quantities which negatived the possibility of anaerobic conditions Moreover, examination of the subsoil demonstrated that the conditions were aerobic, and the production of anaerobic gas on the requisite scale would have involved sewage decomposition in unacceptably large quantities Alone, the coal gas theory was consistent with all the facts Recommendations concerning ventilation and gas leakage are made, it being suggested that underground cavities, including manholes, should be either continuously ventilated or filled in, that the use of a continuous gas detector would be desirable, and that the gas company concerned should strengthen its organisation for the detection of leakage.

DR A. D. LITTLE, president this year of the Society of Chemical Industry, who intends to sail for England on June 15 in order to preside over the annual general meeting at Manchester on July 9, has sent a personal message to American and Canadian members of the Society expressing the hope that many will take advantage of the opportunity of consolidating the friendships so happily begun at the meetings of last year and establishing new ones under peculiarly favourable auspices. The Raymond and Whitcomb Co , which is dealing with transport arrangements, points out that June 28 and 29, the last sailing dates which will assure members reaching Manchester in time for the opening meetings, are the heaviest of the entire season, so that early notification of probable requirements is necessary. The programme in connexion with the annual general meeting commences on Monday, July 8, and continues until Saturday, July 13 , it includes addresses by the president, by Prof Pear, and by Sir Richard Threlfall, visits to works, excursions, the annual dinner, and a number of social gatherings. American chemists and chemical engineers who may find it possible to visit Great Britain in connexion with these meetings may be assured of a cordial welcome from their British colleagues, by whom the occasion is being anticipated with much pleasure

IN opening a discussion at the Society for the Study of Inebriety on alcohol in therapeutics on April 9, Dr J. D. Rolleston said that from the earliest times the subject has given rise to acrimonious discussions in the medical profession. On the introduction of distilled liquors into medicine in the thirteenth

century, the new remedy was regarded as a panacea and as an elixir of life, as was shown by the terms *aqua vitæ* and *eau de vie*, though the designation of *eau de mort*, used by Voltaire several centuries later, appeared more applicable. The remarkable decline in the therapeutic use of alcohol within the last thirty years is best illustrated by the fall in the alcohol bill in various hospitals, but is also shown by the practice of individual physicians and the small place which alcohol now occupies in modern text-books of medicine compared with those of forty years ago, when the writers, still imbued with the medieval doctrine, extolled the therapeutic value of different alcoholic beverages in a great variety of diseases At the present time in the United States only a minority of practitioners have applied for a licence in those States in which the right to prescribe alcohol is granted The conditions in which alcohol is still chiefly employed are pneumonia, enteric fever, diphtheria, and other acute infections, diabetes, heart disease, tuberculosis, inoperable cancer, and senility, but it does not appear to be indispensable in any of them In conclusion, Dr. Rolleston maintained that the factors chiefly responsible for the undeserved esteem which alcohol still enjoys as a therapeutic agent are tradition, rather than scientific evidence, extra-medical influences, and personal considerations.

All cities in the world with populations of more than half a million are being faced with the problem of transporting large numbers of workers daily from one section of the city to another For London, Captain Swinton and Col M. O'Gorman are advocating a raised ring road 15 miles in circumference which would pass near the eleven railway termini and Earl's Court According to an article in the *Westinghouse International* for May, considerable relief for congested traffic can be obtained by using modern electric cars operating in subways or on overhead tracks Some of the new cars are more than 42 feet long and weigh 15 tons. No other vehicle can haul so many people with equal safety at such a low fare. In America, in one city alone the inauguration of a new electric rapid transit system is calculated to save one hundred thousand passengers one hour daily. Cars are now made to accommodate 104 passengers comfortably, fifty-horse-power motors being used. Trackless trolley buses are also successfully operated in many cities in the United States They are of the six-wheeled type, weighing about 8 tons, using fifty-horse-power motors and taking their power from an overhead 600-volt trolley wire. A large number of petrol buses are now being supplied with electric equipment, which usually consists of a generator and one or two motors. It is claimed that these petrol-electric vehicles have many advantages over those operated purely mechanically They accelerate much more smoothly, and owing to the absence of gears there is very little noise These improvements are the result of long-continued experimental researches.

The Manson Medal of the Royal Society of Tropical Medicine and Hygiene, awarded triennially, is to be presented this year to Sir Ronald Ross. It was founded in memory of Sir Patrick Manson in 1922, and has been awarded to Sir David Bruce and Senator Ettore Marchiafava Qualifications for the medal are contributions of outstanding merit to knowledge of tropical medicine and hygiene The Chalmers Medal, which was founded in 1921 by Mrs Chalmers in memory of her husband, Dr Albert J Chalmers, is awarded every second year to the younger workers in the field of tropical medicine and hygiene, who must be under forty-five years of age on June 1 of the year of award It is to be presented this year to Major J A. Sinton, previous awards have been to Prof E Roubaud, Prof Warrington Yorke, and Dr. H. Lyndhurst Duke Though the Manson Medal was founded in memory of Sir Patrick Manson, the Society is endeavouring to found a more substantial memorial in the shape of a permanent home for the Society. To this end the "Manson House" Fund was started, and already donations have brought in £4373, while £3000 have been promised on loan without interest. It is hoped that a sufficient sum will now soon be raised to enable the Society to purchase suitable premises which will form the headquarters of the Society and will be named after Sir Patrick Manson, the first president of the Society

The tenth annual meetings of the American Geophysical Union and of its sections will be held in the National Academy and Research Council Building, Washington, D C, on April 25 and 26 Following the business meeting of the general assembly of the Union on the afternoon of April 26, the Union will hear the five following general-interest papers, all relating to current or recent work, presented by the Section of Oceanography. The expedition of the submarine S21 to the Caribbean Sea and Gulf of Mexico, by C S Freeman, oceanography and the fisheries, by Henry B Bigelow, the international ice patrol, with special reference to its economic aspects, by Edward H Smith; the co-operative survey of the Great Lakes, by Charles J Fish; the work of the *Carnegie* to date, by W J Peters. The six sections, dealing respectively with geodesy, seismology, meteorology, terrestrial magnetism and electricity, oceanography, and volcanology, will hold short business meetings to be followed immediately by progress-reports and scientific papers The scientific sessions will be open to persons interested in geophysics, whether members of the Union or not. These annual meetings are increasingly interesting each year, not only because of the stimulus afforded the study of problems concerned with geophysics, but also by reason of the co-operation of the corresponding geophysical organisations of Canada and Mexico, which is making for initiation and co-ordination of geophysical researches depending upon international and national co-operation.

In the course of his presidential address to the Institution of Professional Civil Servants at the annual general meeting on April 12, Sir Richard Redmayne dealt with the position of the technical expert in the civil service He referred to the claim which the Institution is putting forward on behalf of scientific

members of the Civil Service, of whom, thanks to the understanding it has recently reached with the Association of Scientific Workers, it is fully representative. The claim is not just a demand for 'more money', it is based upon the thesis that a modern State must accord to the scientific worker a status and a sphere of influence as high and as extensive as are enjoyed by those whose duty it is to take what is usually known as 'the decision.' The case of the scientific worker is, however, only one aspect of a much larger problem, namely, the status of the technical expert in public administration. The Institution is of opinion that the watertight division between 'administrators' and 'technical advisers' is leading to inefficiency and waste owing to the absolute power placed in the hands of the administrator to determine matters of policy in regard to which technical considerations may be paramount At the present time the organisation of the Civil Service is on the basis of the needs of departments of State some two generations ago. The reorganisation of the Service in the light of scientific progress is of such vital public importance that it calls for an inquiry by a public body The Institution, the chief aim of which is increased efficiency of the public service, will not rest content until such an inquiry has been made

SIR HUBERT WILKINS intends to return to the Antarctic in September to continue his explorations by aeroplane. He has given an account of his plans in the *Times*. From Deception Island, where his Lockheed machines are now stored for the winter, he and Lieut. Eielson will fly south to Hearst Land along the western coast of Graham Land. On this long flight no landing-place is assured, for the coasts are rugged and the sea will be open, but strewn with ice. Sir Hubert suggests that tabular icebergs might afford emergency landing-places. On the other hand, they may not be available. On Hearst Land a depot will be made, and there the aviators will await reports of favourable weather conditions from the whalers and Commander Byrd in the Ross Sea before starting on the flight of 2000 miles to King Edward Land along the unknown coast-line of Antarctica. This must be a risky flight, for conditions are entirely problematical, but it should be possible to cover the distance between successive blizzards. Sir Hubert hopes to locate a suitable site for a meteorological station, and in any event he will, if successful, add a considerable stretch to the coast-line of Antarctica.

MR A. M. DANIEL, director of the National Gallery; Dr. Cyril Norwood, headmaster of Harrow School, and Mr. W J Tapper, president of the Royal Institute of British Architects, have been elected members of the Athenæum under the provisions of Rule II. of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service

WE are informed that, as a result of a recent meeting, a body has been constituted under the title of the "Ultra Violet and Allied Trades Association," consisting of a number of the leading firms engaged in the design, manufacture, and marketing of ultra-violet, physio-therapy, and other electro-medical apparatus in Great Britain The Secretary of the Association is Mr C Rodgers, and the offices are at Kern House, 36 Kingsway, London, W.C.2.

THE Swedish Government has placed an order with the Marconi Company for the supply of a 60-kilowatt aerial energy transmitter for installation at Stockholm The fact that this contract was obtained by the Marconi Company in the face of keen competition is a tribute to the excellent design and performance of British broadcasting transmitters already installed in more than twenty countries outside Great Britain. The new Swedish broadcasting station will be effective over a very large area It will be operated on the low-power modulation system, with deep and distortionless modulation, and will be worked direct off a three-phase public electric power supply.

MR. H. V. GARNER and Capt. E. H Gregory will again be available to demonstrate the Rothamsted and Woburn Experimental Plots during the summer to farmers' and other bodies interested in agriculture or market gardening At Rothamsted the soil is heavy The experiments deal with the manuring of arable crops, grazing land, and hay land, with crop diseases and pests, and with new methods of laying down of land to grass. At Woburn the soil is light. The experiments there are concerned more particularly with the manuring of potatoes, sugar beet, wheat, malting barley, and the use of green manures. Communications should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden.

A CATALOGUE (No. 167) of second-hand books of science, ranging over most branches, has just been published by Messrs. Dulau and Co., Ltd., 32 Old Bond Street, W.1. It can be obtained free upon application. There are upwards of 1400 items listed and the prices asked appear very reasonable.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A general engineering master at the Acton Junior Technical School—J. E. Smart, Municipal Offices, Acton, W.3 (April 27). An inspector under the Ministry of Agriculture and Fisheries for the purposes of the Diseases of Animals Act, 1894–1925—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (April 29). A second assistant in the County Analyst's Laboratory, Derby—The County Analyst, County Offices, St. Mary's Gate, Derby (April 29). Two assistants on the higher technical staff of the Victoria and Albert Museum—The Director and Secretary, Victoria and Albert Museum, South Kensington, S.W.7 (May 4). A lecturer in civil engineering and building trades work in the engineering department of the Portsmouth Municipal College—The Secretary, Municipal College, Portsmouth (May 4). A lecturer in economics at the City of Birmingham Commercial College, with special qualifications in transport subjects—The Principal, City of Birmingham Commercial

College, Suffolk Street, Birmingham (May 4). A workshop instructor in carpentry and joinery at the Birmingham Central Technical College—The Principal, The Central Technical College, Suffolk Street, Birmingham (May 6) A technical officer for the Air Ministry Technical Development Staff, primarily for work at the Royal Air Force Base, Gosport, in connexion with the development of torpedoes for aircraft use—The Secretary, Air Ministry (S.2) (quoting B.335) (May 11). A research assistant in the department of coal gas and fuel industries of the University of Leeds, for work in connexion with the Joint Research Committee of the Institution of Gas Engineers and the University—The Registrar, The University, Leeds (May 12) A post in the zoological department of the University of Manchester—The Registrar, The University, Manchester (May 14). A professor of physiology in the University of Bristol—The Secretary, The University, Bristol (May 16). An assistant lecturer in physiology in the physiological department of the University of Birmingham—The Secretary, The University, Birmingham (May 31). Probationers for the Indian Forest Service—The Secretary, Services and General Department, India Office, S.W.1 (July 1). An assistant in the mechanical engineering section of the Engineering Department of the Halifax Municipal Technical College—The Principal, Municipal Technical College, Halifax. A medical woman with experience in teaching anatomy, to act for the professor at the Lady Hardinge Medical College, New Delhi—The College Principal, Lady Hardinge Medical College, New Delhi, India. A laboratory steward in the physics department of the Military College of Science, Woolwich. A qualified technical chemist at the Stores Inspection Department of the Office of the Crown Agents for the Colonies—The Crown Agents for the Colonies, 4 Millbank, S.W. (quoting O/Sec. Office 91)

Our Astronomical Column.

The Radius of Space—The following cablegram (which has been somewhat expanded from its very concise telegraphic wording) was received from Dr. Ludwik Silberstein on April 10: "A star formula which is developed in the course of my monograph 'The Size of the Universe,' now in course of publication at the Oxford University Press, when applied to 35 stars of type O yields for the radius of space the value 3.2×10^{11} astronomical units; when applied to 29 Cepheids, 3.0×10^{11}, and when applied to the 246 more distant stars of Young and Harper's list, 3.4×10^{11} units The latter computation was completed on April 7; its agreement with the two former ones definitely establishes that space is finite, and that its radius is thirty trillion miles (in the British use of the term), or about five million light-years"

The Einstein theory has familiarised us with the idea of space being limited and re-entrant into itself; the surprising point in the above communication is the much smaller value that is assigned to the radius than has been found by other methods. It is, indeed, only a small fraction of the estimates of the distances of the fainter spiral nebulæ that have been assigned in recent years by Profs. Hubble and Shapley, these go up to 140 million light-years. The acceptance of Dr Silberstein's value would mean a drastic revision of the whole method of determining distances by the periods and apparent magnitudes of Cepheid variables; assuming its truth for the moment, we note that the two spirals, the distance of which Hubble found to be about a million light-years (the Andromeda nebula and Messier 33), should also be visible in the opposite direction, since their distance by that route would be only nine times as great as by the shorter route; it so happens that there are conspicuous nebulæ very near the opposite points—*h* 3433 and Messier 83 respectively; their positions for 1860 are respectively R.A. $12^h\ 44^m\ 37^s$, S. Decl 40° 18·7′, and $13^h\ 29^m\ 9^s$, S. 29° 9.0′. The appearance of Dr. Silberstein's monograph will be awaited with interest, but in the meantime his announcement will necessarily be received with some reserve.

The Spectrohelioscope —Prof. G. E. Hale, the inventor of the spectrohelioscope, contributes an article upon it to the *Scientific American* for April, he shows that it is not a mere toy, designed to enable the eye to discern features that could be equally well studied by photography, in fact, in several respects it gives the observer powers of study much greater than those afforded by the photographic plate This only records the aspect at a single instant, whereas the observer with the spectrohelioscope can quickly detect the most active regions of the disc, and follow the changes continuously. Prof Hale says "I have frequently seen the swift flow towards sunspots of masses of hydrogen larger than the earth, adequately recorded with the spectroheliograph only once in twenty years."

Prof. Hale goes on to describe a further improvement, the 'line shifter'; this is an adjustable plate of plane glass behind the second slit, which permits the observer to set different parts of the width of the line on the slit in quick succession; this gives information about the radial motions in different regions of the formation One side of an arch may be seen to be rising, while the other is falling Prof. Hale has prepared instructions whereby a handy person can construct a spectrohelioscope at a cost "comparable with that of a fine radio set"

Greenwich Observations of the Sun and Planets.—The Astronomer Royal and Mr R. T. Cullen contribute a paper on this subject to the January number of the *Monthly Notices* of the Royal Astronomical Society. The study of the solar observations is carried back to those of Bradley, beginning about 1750. It was found that early observations of the sun in right ascension were subject to large errors; those in declination appeared to be more satisfactory. Accordingly, the error in longitude has now been deduced from the observations of declination made near each equinox, this is a similar process to the well-known method of Flamsteed for determining the equinox. The 'secular acceleration' of the sun is clearly shown by the residuals. The coefficient of T^2 is deduced as $+0.78''$, which is comparable with that found by Dr. Fotheringham. The solar residuals show oscillations which accord fairly well in period and phase with those of the moon, but are about one-tenth of the amplitude.

As regards the outer planets, the residuals of Saturn changed abruptly from + to − at the date of the introduction of the moving wire, 1915. Those of Neptune have been changing fairly uniformly from zero early in the century to $-3''$ in 1928. Its latitude also shows progressive change, but not quite so regular.

Research Items.

A Pregnancy Custom in West Africa.—Dr. J. Maes describes in *Man* for March a recent acquisition of the Musée du Congo Belge from the Katanga which is connected with a child-birth custom distributed through a wide area in West Africa. The object is a clay figurine of a seated female figure holding on her lap a disproportionately large bowl. The stylisation of the hair indicates that the figure represents a woman of the Bena Kanioka. It is the first record of this custom among these people, though figures of this type are common among the Baluba. These figures are made by men during the pregnancy of their wives. When the time of delivery approaches, and the woman is no longer able to work in the fields, the figure is placed at the door of the hut and all passers-by place alms in the bowl. These gifts are shared among the woman's friends when they return at night in return for the produce of their fields which they give the expectant mother, and for labour which they have expended on her garden. This custom is found among the Yoruba, and clay figures made by the peoples of the Gulf of Guinea exhibit exactly the same characters as these from the south of the Belgian Congo.

The Tasmanian Skull.—Prof. Wood-Jones (*Jour. Anat.*, vol. 63, pt. 2, pp. 224-232) in a recent paper gives a group of four graphic reproductions of the average or composite skull of the Tasmanian, the first of a series of racial types with which he proposes to deal in turn. The reproductions include the normæ lateralis, facialis, occipitalis, and verticalis, and are based on ninety skulls. The author finds that the whole cranium presents a rounded and well-filled contour which is considerably in advance of that shown in figures usually given in works on physical anthropology. The temporal fossæ are well filled and the vault of the skull evenly rounded in facial view. The forehead is not markedly narrow nor is the vault of the cranium low or long. The cranial capacity, using Lee's formula, averages 1353 c.c., or, using the formula of Broca and Manouvrier, 1424 c.c. This is high compared with the previous estimates of 1220-1230 c.c. The author concludes that the commonly accepted low average cranial capacity in this race, like the reputedly humanly low-class features of the cranium, has been wrongly emphasised, with the result that the Tasmanian has been ascribed a lower place in the human scale than the examination of his cranium warrants.

Spawning Migration of Salmon.—A report just received from Russia ("Physico-chemical characteristic of breeding migration fast of Keta Salmon," by Prof. B. P. Pentegoff, U. N. Mentoff, and E. F. Kurnaeff. *Bulletin of the Pacific Scientific Fisheries Research Station*, vol. 2, part 1. Vladivostok, 1928) contains an interesting study of the breeding migration fast of the Keta salmon. It is stated that the total distance traversed by the Amur River autumn salmon during the spawning migration is about 1200 kilometres in the river alone. The information upon the sea portion of the migration is meagre, but on the basis of a single marked fish liberated from the Island of Unda and later recaptured in the River Pankara, Kamchatka, the authors conclude that the sea migration is similar to the river migration, that is to say, in a contranatant direction and towards increased temperature. During this portion of its migration the fish travelled at a rate of 70 kilometres per day for 34½ days, without food. Perhaps the main value of the paper lies in the detailed physical and chemical studies of the fish at all stages of the journey up-river, during which the speed of the fish is said to be on the average 115 kilometres per day, and to be in inverse ratio to the speed of the current. A total of 172 fishes (equal numbers males and females) were subjected to minute analysis. From the sea to the time of death after spawning, the males lost 77.21 per cent of their reserves of energy, and females 78.75 per cent. At first the proportion of energy expenditure from the destruction of fat to that from the destruction of protein increases, but this relation is later reversed. It is calculated that the average daily expenditure of energy in their passage up the river is 25,810 small calories for males, and for females, 28,390 small calories, for each kilogram of live weight. Among the more important chemical changes in the muscular tissue are the following: From the sea to the time of death at the spawning ground, the loss of fat was 98.72 and 97.27 per cent in males and females respectively; of proteins, 57.29 and 57.68 per cent; of ash, 47.03 and 47.07 per cent; and of water, 15.18 and 20.74 per cent respectively.

Bryozoa and Algæ of Mutsu Bay.—Dr. Yaichiro Okada reports on the cyclostomatous Bryozoa and Mr. Yukio Yamada on the marine Algæ of Mutsu Bay ("Cyclostomatous Bryozoa of Mutsu Bay" and "Marine Algæ of Mutsu Bay and Adjacent Waters, II," *Report* of the Biological Survey of Mutsu Bay, 8 and 9. *Science Reports of the Tôhoku Imperial University*, 4th Series (Biology). Sendai, Japan, vol. 3, No. 4, Fasc. 1, 1928). Both papers are contributions from the Marine Biological Station, Asamushi, Aomori-Ken. The Bryozoa in their zoogeographical distribution combine the characteristics of the Pacific boreal sub-region and the Indo-Pacific coastal region. In continuing his work on the marine algæ, Mr. Yamada has himself made extensive collections, adding very appreciably to the knowledge of the flora of the district. Not only does he record and describe many rare forms, but, what is really more important, he also shows that many species are common which were not before known to live there at all. Some of his most interesting finds belong to the Elachistaceæ, growing in pools on fronds of *Sargassum* and *Phyllospadix*. Fifty species of algæ are recorded in the present report, making 86 in all, 6 of which are new.

Non-proliferating Bacteria.—In two papers (*J. Hygiene*, 28, pp. 139-46; 1928, and *Ann. de la Brasserie et de la Distillation*, Dec. 10, 1928), Dr. J. H. Quastel sums up the interesting results which he and his colleagues have obtained at the Biochemical Laboratory, Cambridge, by the study of non-proliferating, or, as they were at first less happily termed, resting bacteria. The organisms are used in the form of a suspension under such conditions that practically no growth occurs during the observations, and the chemical changes can thus be studied without complication. The properties of such organisms have been intensively investigated in the case of *B. coli*, which has the power of activating a very large number of substances, that is, rendering them capable of performing chemical reactions, such as reducing methylene blue, which they cannot perform in the absence of the cell. The degree of activation produced varies greatly with different substances, and, moreover, the activating powers towards different substances are very differently affected by varying modes of treatment of the organism. Thus, after treatment with toluene, glucose is no longer activated,

whereas formic acid is as powerfully activated as before the treatment Facts of this kind have led the author to the view that activation of the substrate is not necessarily due to the existence of specific enzymes. He suggests that activation, which consists in a polarisation (an internal electrical change) of the substrate molecules, occurs at particular regions or centres on the surface structures (interfaces) of the cell. Activation is conditioned by the specific adsorption of the substrate at the activating centre, the constitution of the substrate molecule and the nature and strength of the polarising field This theory is successfully applied to the explanation of the observed phenomena of activation and of the conditions necessary for anaerobic growth.

SUGAR BEET TRIALS —The report of the second year trials of sugar beet carried out by the University of Bristol on some thirty-three local farms adds very little indeed to the information already available as to the cultivation and manuring of that crop As a widespread demonstration, this experiment may have served its purpose in giving the farmers illustrations of the cultivation and manuring of what is after all a comparatively new crop, but the results obtained must not be regarded too seriously. The trials had a wide range, and covered cultivation, time of application of nitrogen, and the form of nitrogen to be applied, and on the results one draws the general conclusion that a moderate application of one or other of the soluble nitrogenous fertilisers will produce an increase in yield which is sufficiently great to make the practice profitable. This cannot be considered as new information, but it may serve to confirm over a considerable area of cultivation the results of smaller individual trials carried out in various parts of Great Britain from about 1877 until the present time It is interesting to notice that the yields obtained in the trials now described are relatively high Even without nitrogen, and over a range of soils including Greensand, Bunter crag, and Old Red Sandstone, an average of 12 2 tons of washed beet per acre was obtained The average obtained by Great Britain as a whole during last season was about 8 tons of washed beet per acre. Within this margin, between the eight and the twelve, lies the future of sugar-beet growing in England, for unless the return per acre improves it is almost certain that the reduction of acreage which was seen last year will continue in future years and the factories will be unable to find acreage to support themselves. If such trials as those reported upon from Bristol serve only the purpose of showing the growers how increased yields may be obtained without undue increase of expense, then they may well find justification for their continued existence.

NEW GASTROPOD FROM THE SILURIAN OF ALASKA.—From the same Upper Silurian horizon in Alaska whence he obtained the remarkable bivalve *Pycnodesma* (see NATURE, Oct. 22, 1927, p. 600), Mr. Edwin Kirk has now described (*Proc. U.S. Nat. Mus.*, vol. 74, art. 18) an equally interesting new gastropod to which the name of *Bathmopterus liratus* has been given. The shell superficially resembles *Euomphalopterus*, but has a well-defined slit band and is apparently referable to the Pleurotomariidæ, or possibly the Euomphalidæ The specimens here described and depicted came from Willoughby Island in Glacier Bay.

MOLLUSCA FROM THE GULF OF CALIFORNIA AND THE PEARL ISLANDS.—Mr. H. P. Bingham, of New York, following in the footsteps of the late Prince Albert of Monaco, has been conducting expeditions in his yacht *Pawnee* and forming a collection for the purpose of oceanographic research at the Peabody Museum of Natural History, Yale University, while a *Bulletin of the Bingham Oceanographic Collection* is published in connexion therewith. Although the primary object has been ichthyological research, other branches have not been passed by altogether, and Lee Boone describes in the *Bulletin* (vol. 2, art 5) the mollusca dredged in 1926 during an expedition to the Gulf of California and the Pearl Islands of the Gulf of Panama. Considering the faunal richness of the region as revealed by Carpenter, Adams, and Dall, the list is a small one, but several of the species now obtained were rare, and one, *Tellina barbaræ*, from the Pearl Islands, is new. Six of the species are figured, by half-tone process from photographs, on three plates, which are distinctly works of art.

TRINIDAD WELL-WATERS.—It is seldom that a study of oilfield waters is of less significance, either in itself or in its bearings on exploitation problems, than the study of petroleum in any region, and Trinidad has shown itself to be no exception to this statement. The technical data requisite to geochemical interpretations of the various waters encountered in oilfields here, have taken time to accumulate ; although developments have been in progress for several years past, not until now has it been possible to present a co-ordinated account of the hydrology of these oilfields as a basis of geological and economic considerations Messrs J. S. Parker and C A P Southwell's recent paper, read before the Institution of Petroleum Technologists, emphasises such considerations by showing that, as in most other cases, chemical investigations of associated waters with oil, lead to anticipation of water-bearing strata likely to be penetrated by drilling wells , with such fore-warning, casing programmes can be arranged accordingly and preparations for water shut-off at specified depths be initially made ; the data are also available, when correctly interpreted, as confirmatory evidence of subsurface structure, particularly when the strata involved are unfossiliferous ; in the event of salt water invading a well or flooding an oil-sand (through leaky casing or faulty seating), the source of such water may be determinable ; while the discrimination between different waters (top, intermediate, bottom, edge), when possible, elucidates both extent and trend of oil-reservoir rocks and of oil accumulation therein. In short, the authors demonstrate that, now the essential chemical data are available to operators in Trinidad, solution of existing problems concerned with different waters in different fields should be possible, and future developments will have an advantage of the geochemical interpretations which their researches on the subject have made possible

TRUE BEARING AND DISTANCE DIAGRAM —A true bearing and distance diagram has been devised by Mr. E. A. Reeves and published by the Royal Geographical Society (price 7*s*. 6*d*.). The diagram consists of the network of a hemisphere on the stereographic projection. By its aid the true bearing of any point on the earth's surface from any other point can be easily found. It also gives the distance between the two stations and allows the drawing of the arc of a great circle between them The diagram should prove of great value in survey expeditions obtaining wireless time signals in connexion with longitude determination. Along with the diagram and pamphlet of instructions, there is given a spare unfolded copy on strong cartridge paper with a radial pointer.

THERMIONIC VALVE POTENTIOMETER FOR E.M.F. MEASUREMENTS.—Most of the applications of thermionic valves to the determination of E.M.F. measurements have the disadvantage that they depend upon the constancy of the valve characteristics and require constant sources of filament and plate potentials. An apparatus described by H. M. Partridge in the *Journal*

of the American Chemical Society for January is claimed to be free from these limitations and may be used with cells of very high resistance, such as a cell containing two glass electrodes, since it is essentially electrostatic in operation A four-electrode valve, together with a three-electrode valve, is used, the second valve acting as an amplifier giving greater sensitivity. No calibration of the valves is necessary, and the E M F is read directly from a voltmeter in the grid circuit of the first valve The accuracy depends largely on the degree of precision of the voltmeter.

MOLECULAR HYDROGEN.—Diatomic hydrogen (H_2), although regarded until recently as a simple substance, has been shown by the new mechanics to be capable of existence in two modifications, which have been termed ortho-hydrogen and para-hydrogen by analogy with corresponding helium atoms Considerable support for this idea has already been found in spectroscopic and thermal data, and in a recent issue of *Die Naturwissenschaften* (Mar 15) it has been reported independently by A. Eucken, and by K F Bonhoeffer and P Harteck, that a separation of the components can be effected A Eucken has employed the simple device of holding hydrogen under pressure for some days, at liquid air temperatures, changes in the relative amounts of the two forms present being followed by the increase in the rotational component of the specific heat of the gas In addition to this method, the other investigators appear to have made use of fractional condensation on charcoal at the temperature of liquid hydrogen, as well as direct liquefaction of the gas. They claim to have prepared practically pure para-hydrogen, and state that it is moderately stable if stored in glass vessels under normal conditions of temperature and pressure, reverting only very slowly to the equilibrium mixture on standing, but that the change can be accelerated by an increase in pressure, and that it takes place rapidly under the influence of an electric discharge, or in the presence of platinised asbestos.

A PORTABLE ELECTRIC HARMONIC ANALYSER.—R Thornton Coe gave a demonstration at the Institution of Electrical Engineers on Mar 21 on an electric harmonic analyser for electric waves The operation of the instrument depends on the principle that a dynamometer instrument only gives a steady reading when the currents in the fixed and moving coils have the same frequency. A small current of about the fifth of an ampere is obtained from the voltage or the current to be analysed, and passes through the moving coil of the instrument. Through the fixed coil a current which follows accurately the sine law and the frequency of which can be varied is passed. At the harmonic frequencies large deflections may be produced, and as the analysing current is read on a thermal ammeter the amplitude of the harmonic can be found The chief feature of the apparatus is the method of producing the analysing current by using a special contact disc driven by a small synchronous motor actuated from the alternating current circuit. One ring of contacts is used for each harmonic A tuned circuit is used for improving the wave shape of the analysing current. The instrument obtains each harmonic separately from steady readings on two instruments. It is claimed that by its use alternating current waves can be analysed up to the forty-ninth harmonic. It is of importance in practice to determine the wave shapes produced by electric generators. If an appreciable harmonic be present in the limits of audition, annoying interference with neighbouring telephone circuits may ensue This can generally be remedied by slightly modifying the generator circuits.

ATOMIC WEIGHT REPORTS.—A correspondent points out that the German values for atomic weights given under the above heading in the issue of NATURE for Mar. 9, p 390 (in which the value for phosphorus should read 31 02, and not 31·62) are mainly identical with the values adopted in 1925 by the International Commission on the Chemical Elements in its atomic weight report, which, though not an annual publication, was the successor to the former annual report of the International Committee on Atomic Weights. It thus appears that the German Commission has retained the international values for the elements mentioned (*loc. cit.*), whilst the English sub-committee has used F. W. Clarke's values.

DISTILLATION OF WOOD-TAR IN HYDROGEN —Many years ago the interest of the Russian school of organic chemists in pyrogenic reactions was well known, and that this interest still continues has been shown by the work which has been published in recent years by W. N. Ipatiev from the Academy of Sciences in Leningrad The effect of heating organic substances under pressure in the presence of hydrogen and of alumina and iron catalysts has been investigated, and the results of this treatment on wood tar and tar oil are now described (*Berichte*, vol. 62, p. 401, February 1929). It is found that the use of hydrogen results in an increase in the yield of liquid products, which are richer in hydrocarbons and low-boiling fractions than the products of ordinary ‘cracking’ Correspondingly, there is a decrease in the proportion of unsaturated compounds formed, and this is reflected in the loss of the unpleasant smell which is a disadvantage of the ordinary product, and in the absence of a tendency to darken on keeping. The authors, Ipatiev and Petrov, suggest that the new products might be used for extraction or lubricating purposes.

THE NICKEL-CHROMIUM PLATING PROCESS.—Chromium is being extensively used instead of nickel as a protective coating for iron, not only for the purpose of producing a highly lustrous and durable surface, but also for the surface-hardening of bearings. That it has not yet displaced nickel is due to the difficulties encountered in electroplating. In an article in the *Chemiker-Zeitung* of Mar. 13, Prof. Pfanhauser, director of the Langbein-Pfanhauser-Werke A.-G., Leipzig and Vienna, deals with these difficulties and describes how they have been overcome by a method which is protected by the patents of the Chrom-Interessen Gemeinschaft. By using a high current-density, the time required to produce a stable and highly resistant coating of chromium has been reduced to five or ten minutes, the original iron or brass having previously received a layer of nickel 0 02-0 025 mm thick The advantages of using an intermediate layer of nickel are twofold, for not only is the cost of plating very greatly reduced, but also the risk of corrosion of the iron or brass by traces of chromic acid, deposited with the metal, is obviated. The chief disadvantage has hitherto been the tendency for both metals to peel after a short time. The reason for this is that some hydrogen is deposited with the metals at the cathode. In order to overcome this defect, it is necessary in the first place to pay special attention to the deposition of the nickel, which must be sufficiently thick, and at the same time poor in hydrogen, to be able to absorb by diffusion the gas which is associated with the chromium layer Old-fashioned nickel-plating processes may be quite unsuitable for the purpose, and the solutions require very careful control A further source of trouble is due to traces of grease or oxide on the original metal, particularly on brass, which will ultimately cause blistering.

Geological History of the Atlantic Ocean.[1]

THE Atlantic is the best test case for the theory of the permanence of the ocean basins. According to one view, the Atlantic trough is a primeval geographic feature and dates back to the pre-Palæozoic According to an alternative view, it has been repeatedly so broken up by lands trending east to west across it that there has often been no sea entitled to the name of the Atlantic.

The Icelandic Ridge, the northernmost of these cross lands, is generally accepted, and it was probably finally severed between the Upper Palæolithic and the Neolithic. This land is shown by varied evidence from different geological periods to have extended as far south as a line from Newfoundland to Ireland, or to the Azores. It formed the northern shore of the Tethys.

The main issue regarding the Atlantic relates to the southern side of the Tethys and the Brazilio-Ethiopian land. That the South Atlantic was occupied by land in the Palæozoic era is indicated by the absence of marine rocks from most of both coasts From Upper Carboniferous to Lower Jurassic times, Brazil and Africa were parts of Gondwanaland, and a southern fauna and flora ranged through both. The invasion of this land by the sea began in the Middle Cretaceous Period, with gulfs from the Mediterranean which reached Brazil and Angola · they were closed to the south, as the marine fauna of Cape Colony is distinct and ranged westwards through Chile, and as the fresh-water fauna was continuous between Africa and South America

This continuity is shown by the river fish, porcupines, lizards, snakes, and many invertebrates, of groups that were in existence in the Lower Kainozoic era The evidence shows that the connexion lasted until the end of the Oligocene, but it cannot have lasted much later, as the more specialised mammals and birds—for example, the humming-birds—did not use it as a land bridge

The existence of this land-connexion in Oligocene times is shown by the occurrence of the same shallow-water marine animals in the West Indies and in the Mediterranean Some of them might have crossed by a chain of islands, but that the land was continuous is shown by the marine mollusca of the West Indies and the Mediterranean being distinct from those in the south The first commingling in South America was in the Upper Miocene (Entrerios Beds), according to H von Ihering A slight temporary land-connexion was established in the Upper Miocene, as shown by the migration of *Hipparion gracile* to Europe and of African antelopes to the United States.

This land-connexion was severed too early to have served as Atlantis, though the Canaries may have been joined to the mainland up to the Pleistocene There is no geological evidence of any land-connexion of Africa and South America in the time of man.

The Atlantic is a relatively young geographical feature and due, as held by Suess, to the growth of two gulfs, which projected northwards and southwards from the Tethys. These gulfs were formed by subsidences which began in the Middle Cretaceous and have continued to the Pleistocene, and they finally united the Arctic, the North Atlantic (Poseidon), and the Nereus or the South Atlantic. The Atlantic trough is the greatest of meridional geographical features, and is due to the collapse of a belt of the crust along faults and tensional fractures connected with the pressure of South America westward against the Andes

[1] From the presidential address to the Geological Society of London, delivered by Prof J W Gregory, F R S, on Feb 15

Cylinders for the Storage and Transport of Gases.[1]

THE publication of the third and fourth reports of the Gas Cylinders Research Committee of the Department of Scientific and Industrial Research completes the work of that Committee. The first report dealt with ordinary commercial cylinders for permanent gases, the second with the periodical heat treatment of carbon steel cylinders, and recommended that such cylinders should be made of 0·45 per cent carbon steel as an alternative to the 0 25 per cent carbon steel approved in 1895, whereby the working stress in the cylinders would be raised from 8 to 10 tons per square inch, while the weight would be reduced by about 20 per cent. The first report (see NATURE, **109**, 460; 1922) is now out-of-print, but a revised summary of the recommendations it contained has been issued lately.

A further reduction of weight to one-third of that recommended by the 1895 Committee is possible by the use of alloy steels. This is called for in the case of cylinders used for medical, aeronautical, and mine-rescue work, and the question of constructing cylinders of duralumin and alloy steels containing nickel, chromium, and molybdenum has been examined by the Committee. The third report gives details of this investigation. Commercial and mechanical difficulties rather restricted the scope of the work, and alloy steel cylinders alone have been investigated properly. The Committee recommends the use of nickel-chromium-molybdenum steel cylinders for the storage and transport of 'permanent' gases, the steel to have the following composition Nickel, 2·5 per cent, chromium, 0·6 per cent, molybdenum, 0·6 per cent, manganese, 0·6 per cent, carbon, 0·3 per cent, silicon, 0·15 per cent; sulphur, 0·4 per cent (max); and phosphorous, 0·03 per cent (max), and the remainder iron, and to have the following mechanical properties. Ultimate tensile strength, 55-65 tons per square inch, yield stress, not less than 45 tons per square inch, an elongation not less than 18 per cent on 2-inch gauge length Seamless and weldless finished cylinders of about 20 cubic feet of gas capacity are required to be subjected to a hydraulic proof pressure of 2700 lb per square inch, to stand a pressure of 2550 lb per square inch and show no sign of leak, and to withstand the impact of an armour-piercing bullet (Mark vii P) without bursting when filled with air at a pressure of 1800 lb. per square inch. The thickness of the cylinder wall for cylinders of 4 inch outside diameter must not be less than 0·080 inch, and particles of shale, oil, grit, filings, etc, must be carefully removed from the cylinder. They are to be subjected to the hydraulic test at least once in every two years

The considerations that are of importance in the case of cylinders used for the storage and transport of *liquefiable* gases are radically different from those ruling in the case of permanent gases. In the former case, so long as the cylinder is not *completely* filled with liquefied gas, the internal pressure is the saturation pressure, and this in general is quite low and

[1] Department of Scientific and Industrial Research Ordinary Commercial Cylinders for the Permanent Gases Summary of Recommendations (Revised) Pp iii+7 4*d* net Third Report of the Gas Cylinders Research Committee (Alloy Steel Light Cylinders). Pp iii+74+13 plates 2*s* 6*d* net Fourth Report of the Gas Cylinders Research Committee (Cylinders for Liquefiable Gases) Pp. v+151 4*s* net (London · H M Stationery Office, 1929.)

increases *relatively* considerably, but *absolutely* only slightly with rise of temperature Liquefied gas, however, has a relatively high coefficient of thermal expansion, and unless a sufficient free space is left in filling a cylinder, dangerous pressures may be developed owing to the cylinder becoming filled with liquefied gas on rise of temperature Cylinders for the permanent gases are designed on the basis that the stresses in a cylinder wall due to internal pressure are limited, say, to one-quarter of the ultimate strength of the material. The same basis, applied to cylinders for liquefiable gases, would result in the production of cylinders altogether too fragile for commercial purposes

These considerations and others are set out in detail in the very interesting fourth report of the Committee. The storage and transport of liquefied sulphur dioxide, ammonia, chlorine, methyl and ethyl chlorides, hydrocyanic acid, phosgene, carbon dioxide, nitrous oxide, and ethylene are considered Acetylene was excluded from the Committee's terms of reference It is recommended that cylinders for the transport of these gases should be made of seamless tubes of carbon steel produced by the acid or basic open hearth process and having the following approximate composition. Carbon, 0 20–0·25 per cent, sulphur, not exceeding 0 045 per cent, phosphorus, not exceeding 0 045 per cent, manganese, 0 45–0 75 per cent, silicon, not exceeding 0 2 per cent, and the rest iron. Alloy steel is not to be used. The thickness of the cylinder wall is to be dependent upon the maximum internal pressure and the external diameter of the cylinder, and formulæ for deducing such thickness are given in the report After manufacture, cylinders are to be heated uniformly at 860°-890° C and allowed to cool in still air.

Filling ratios for various pressures in temperate and tropical climates for each of the gases are tabulated. Finished cylinders are to be subjected to specified tensile and hydraulic stretch and flattening tests and are to be provided, as in the case of cylinders for containing 'permanent' poisonous or inflammable gases, with completely protected valves, which must be left-handed in the case of cylinders containing inflammable gases Hydrocyanic acid must not be stored for more than 8 months, its purity must be at least 98 per cent and it should be stabilised to prevent polymerisation The valves of cylinders for storing carbon dioxide may be fitted with a safety device, for example, a copper or vulcanite disc forming a gas-tight joint with the valve seat.

The reports contain valuable appendices relating to tests of cylinders, the determination of some of the physical properties of commercial samples of sulphur dioxide, ammonia, chlorine, methyl chloride, carbon dioxide, nitrous oxide, ethylene, hydrocyanic acid, and ethyl chloride

Vertebrate Fossils from Glacial and Later Deposits in Scotland.[1]

THE work referred to below is an important contribution to our knowledge of the vertebrate fossils from the glacial and associated post-glacial beds of Scotland in the Hunterian Museum, University of Glasgow This monograph was planned twenty years ago Various causes have contributed to the delay in publishing, but Prof Gregory and Dr Ethel Currie are to be congratulated on finally bringing the work to conclusion

Several eminent specialists have collaborated in examining and naming different parts of the collection The resulting publication, however, is more than a catalogue of fossils. Detailed and critical descriptions of specimens are first of all given, all the more important examples being figured either in the text or on plates. There follows a series of notes on the localities and geological horizons of the different occurrences In one or two instances the views expressed herein are matters of controversy, but the authors have been careful to direct attention to other opinions It may be noted, for example, that Prof Gregory's belief in the marine origin of Boulder Clay is not generally accepted in Scotland In addition, the interpretation of the evidence as to the exact position of the Cowdon Glen deposits is at variance with that of some other eminent Scottish geologists. It appears in this connexion that Craig's description of the glacial sequence in this locality has been slightly misread. Prof Gregory classes the deposits as Neolithic, but the alternative reading would make them older

The next section of the monograph contains a table showing the distribution in time of the characteristic Scottish mammal remains, with a proposed correlation with the Thames Valley sequence. No Scottish mammals earlier than Lower Mousterian are known Deposits of this age in Scotland are correlated in time with the Late-Middle Terrace of the Thames Valley, and the period of maximum glaciation in both Scotland and England It must be noted, however, as the authors point out, that vertebrate fossils in the glacial and later deposits have been found in very few localities in Scotland, and consist only of isolated fragments Nothing occurs corresponding to the rich Pleistocene vertebrate faunas of south-east England.

The monograph concludes with a comprehensive bibliography. We agree with the authors in hoping that its publication will stimulate interest, and result in further chance discoveries being carefully recorded and the specimens placed in suitable keeping

[1] Monographs of the Geological Department of the Hunterian Museum, Glasgow University 2 The Vertebrate Fossils from the Glacial and Associated Post-Glacial Beds of Scotland in the Hunterian Museum, University of Glasgow, and their Evidence on the Classification of the Scottish Glacial Deposits By Prof J W Gregory and Dr Ethel D Currie Pp vi+26+3 plates (Glasgow Jackson, Wylie and Co; London Simpkin Marshall, Ltd, 1928) 7*s* 6*d* net

H.M. Dockyard Schools and Naval Architecture.

MR A W. JOHNS concludes a series of six articles in *Engineering* for Mar. 29, on "The Dockyard Schools and the Second School of Naval Architecture," a series which fills in a gap in the history of the Admiralty system of training shipwrights and naval architects. Though all Boards of Admiralty have not been possessed with equal zeal in such matters, generally speaking the Admiralty has been a pioneer in technical education. Mr. Johns' articles necessarily present but one aspect of their activities, which to-day range from the training of bandsmen to courses of strategy for captains and admirals. Only so recently as September 1925, Sir W J. Berry and Engineer-Vice-Admiral Sir Robert Dixon gave an account of the Admiralty system of higher education for naval constructors and engineers officers to the British Association, and they stated that it is no exaggeration to say that during the last half-century nearly all advances in warship design have been originated by officers who have passed through the training at Kensington or Greenwich.

Not only have Admiralty students been responsible for advances in warship design, but also many of them have become associated with great shipbuilding firms,

with Lloyds' Register, and with foreign navies, while nearly all the occupants of the various chairs of naval architecture in Great Britain have been held by men whose professional training began in H M. Dockyards or at one of the schools maintained by the Admiralty

The dockyard schools at Portsmouth, Devonport, Chatham, and elsewhere for the education of apprentices, have a continuous history from 1843; and Mr. Johns says they "may be placed amongst the most efficient technical institutions in the country." In the first years of their existence they were inspected six times by Canon Moseley, the mathematician, and to his suggestions may be traced many of the improvements afterwards made. The Schools of Naval Architecture were separate institutions, the first (1811–1832) and the second (1848–1853) being at Portsmouth, the third (1864–1873) at South Kensington, the fourth and still existing one being founded at Greenwich Royal Naval College in 1873. Of the first, Mr. Johns gave an account in *Engineering* in 1926, the third was the subject of an article by Sir William Smith in the same journal in July 1923, and Mr E L. Attwood read a paper to the Institution of Naval Architects in 1905 on the work at Greenwich. Sir William White also referred to the work done at South Kensington and Greenwich in a paper read at the jubilee meeting of the same body in 1911.

Mr. Johns in his articles gives an interesting account of the development of the dockyard schools and of the Second School of Naval Architecture, otherwise known as the Central Mathematical School, and recalls some of the important work done by the professors, masters, and pupils, such as Dr. Woolley, Rawson, Sir Edward Reed, and Sir Nathaniel Barnaby, the last two of whom held the responsible post of Chief Constructor of the Navy. A review of the progress of the various schools and of the careers of those who have passed through them bears eloquent testimony to what can be accomplished by a government department desirous of encouraging talent and industry and of obtaining for itself and the nation at large, workmen and officers with a high standard of professional and technical knowledge.

Studies on the Polysaccharides.

At a meeting of the London Section of the Society of Chemical Industry on Mar. 4, Prof. A. R. Ling, director of the British School of Malting and Brewing, University of Birmingham, described results of recent researches into the structure of starch and glycogen, conducted by himself and his collaborators.

In addition to amylose and amylopectin, the two main constituents of the starch of potatoes, arrowroot, etc., the granules obtained from cereals contain a third substance, amylohemicellulose. Amylose and amylopectin are hexa-amyloses partially esterified as calcium phosphate esters, whilst amylohemicellulose is a silicic ester of amylose. Hydrolysis of starch paste with barley diastase converts amylose quantitatively into maltose, whereas amylopectin yields soluble $\alpha\beta$-hexa-amylose, which is resolved in turn by malt diastase to various glucose derivatives. Amongst these are found glucosido-maltose and isomaltose. Recent study of enzyme action upon these two products has revealed the fact that both possess α-linkages, and not β-linkages as was hitherto supposed.

Prof. Ling has also produced evidence to show that if glycogen, a polysaccharide widely disseminated through the animal kingdom and found also in fungi and in yeast, is not identical with amylopectin, as suggested by Pringsheim, the two compounds are certainly very similar. Samples of glycogen after hydrolysis by malt diastase gave products which could be investigated with the help of the osazone reaction Two compounds were isolated, namely, a disaccharide and a non-reducing sugar. The former agrees in physical properties with isomaltose and possesses a γ (1 · 4) ring. It seems probable that all the oxide-rings in glycogen and amylopectin are of this type and that the conversion of glycogen into lactic acid in the muscles during contraction is best explained by assuming that the glucose involved possesses the γ-structure.

The lecture was followed by an account by Dr F. W. Norris, of Prof. Ling's department, of recent researches on pectin, an important constituent of fruit jellies After reviewing earlier work on the subject, Dr. Norris referred to Ehrlich's resolution of pectic acid into arabinose, galactose, and tetragalacturonic acid. In 1925, Nanji, Paton, and Ling proved that these substances are linked in the proportion of 1 1 . 4 as anhydrides in a ring structure, the acid carboxyl groups being free. An attempt to remove the acid groups, in order to produce a hemicellulose, gave an unexpected result, the product actually obtained being pure galactose-galacturonic acid. The adoption of the ring or hexagon formula helped to throw some light upon the interpretation of analyses of methoxyl-groups, and it seems probable now that the predominating unit in soluble pectin is trimethylpectic acid, which is present in fresh orange juice. Reference was made to recent work by Candlin and Schryver, who obtained a hemicellulose by the action of alkali on pectic acid. Schryver has suggested a new class-name—the polyuronides—for all these compounds.

A wide and interesting field of research has been opened up and much remains to be done to clear up many existing perplexities.

University and Educational Intelligence.

London.—The annual dinner of the fellows of University College will be held at the College on Tuesday, April 30, in commemoration of the laying of the first stone of the College buildings by H R.H. the Duke of Sussex on April 30, 1827. Prof. F. W. Oliver, Quain professor of botany in the University, who was elected a fellow of the College so long ago as 1886, will preside.

The following courses of free public lectures are announced: at Bedford College for Women, at 5.15 on April 29 and May 1, "Abolishing the Arctic," and "The Northward Course of Empire," by Dr. V Stefansson; at University College, at 5 30 on April 29, May 7 and 13, "Geometry · a Brief Review," by Prof H. F Baker, at University College, at 5.15 on April 29 and 30 and May 1, "Drug-like Actions of Some Food Constituents," by Prof. E. Mellanby, at University College, at 5 on May 2, 9, 16, 23, and 30, and June 6, "Special Sense Physiology," by R J. Lythgoe, at St. Thomas's Hospital, at 5 on May 2, 9, 16, 23, and 30, and June 6, "Dietetics," by Prof. S. J. Cowell; at University College, at 4 on May 3 and 10, "Some of the Sequels of Epidemic Encephalitis (Lethargica)," by Prof. A J. Hall.

Applications for agricultural scholarships and agricultural and veterinary research scholarships are invited by the Ministry of Agriculture and Fisheries. Form A.472/T.G for the former and form 900/T.G. for the latter may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1. The completed forms have to be returned by June 15.

Calendar of Patent Records.

April 22, 1823.—The first patent for a roller skate was the English one granted to Robert John Tyers, fruiterer of Piccadilly, on April 22, 1823 The skate had a single line of wheels or rollers, which either were of graduated diameter or were so fitted that their lower edges lay on the line of a circle

April 23, 1784—The well-known cabinet lock of Joseph Bramah—the first of the revolving barrel type—was patented on April 23, 1784, and remains unaltered to the present day. It was one of the first to give real security against being opened by a false key, but that it, like most locks, could be picked by an expert was proved when the American A C Hobbs took up Messrs Bramah's challenge in 1851 and succeeded in opening the lock, though only after 53 hours' work.

April 23, 1793—Sir Samuel Bentham—a brother of Jeremy—is one of the most noted of English inventors His many inventions, not all of which were patented, cover a wide field, but most of his important work was done in connexion with the naval dockyards, where he introduced reforms not only in the methods of shipbuilding but also in office and workshop administration and practice His most famous patent is No. 1951, dated April 23, 1793, the specification of which is a valuable treatise on the application of machinery to the working of wood and metal.

April 23, 1884.—April 23, 1884, is the date of Sir Charles Parsons' patents for the steam turbine The engine was first used for driving dynamos in electricity works, where within a few years its use decreased the coal consumption by one-half The first application to steamships was in the *Turbinia*, which was built in 1894 and attained a speed of more than 32 knots. The engine of the *Turbinia* is now in the Science Museum

April 25, 1793.—On April 25, 1793, there was granted to Captain Joseph Huddart a patent for his new method of making rope cable, in which all the yarns are disposed in concentric cylindrical layers about a centre yarn, an arrangement designed to give a more equable distribution of strain upon the yarn

April 25, 1863.—Linoleum—both the material and the word—was the invention of Frederick Walton, who made his first application for a patent for the new floor-cloth on April 25, 1863. There has been little change in the process of manufacture since its first commercial production at Staines

April 26, 1814—The sewing-machine did not become commercially successful until Elias Howe's United States patent of 1846, but there were several prior inventors who can claim consideration. One of these is Josef Madersperger, of Vienna, who applied to the Emperor Francis I. for an Austrian patent for a sewing-machine on April 26, 1814 A patent for six years was granted to him early in the following year, but the machine was never put into practical use Madersperger's original model was shown at a meeting of the Nied. Osterreichischer Gewerbe-Verein in 1840 and secured for the inventor the society's medal, but in spite of this recognition Madersperger died in extreme poverty. The model is now in the Technical Museum at Vienna

April 27, 1879—Electricity was first used for lighting railway carriages by the London, Brighton, and South Coast Railway, which in 1881 fitted up a Pullman car with an accumulator installation. A system employing a belt-driven dynamo on one of the carriages for supplying current to Geissler tubes throughout the train had, however, been patented in Germany by E. Hinkefuss and Gustav Wesel, engineers of Breslau, on April 27, 1879

Societies and Academies.

London

Geological Society, Mar 20—**Sir Douglas Mawson** Some South Australian algal limestones in process of formation A record of three different types of limestone, now actually in process of formation under the influence of plant-growth, occurring in the south-eastern region of South Australia. In each of the localities examined, whether inundated in winter only or permanently inundated, the formation of limestone is being determined by blue-green algæ.—**Arthur W. Groves** The unroofing of the Dartmoor granite, and an outline of the distribution of its detritus in the sediments of southern England A systematic outline mineralogical survey has been made of the sediments of southern England, from the base of the Permian in Devon (Watcombe Clay) up to the Lenham Beds of the North Downs The minor intrusions above the granite were being rapidly eroded in Permo-Triassic times, but there is no evidence of the actual granite being exposed at that period No proof has been obtained of direct derivation of detritus from the Dartmoor granite in the Jurassic rocks The earliest evidence of the exposure of the granite is in late Wealden times. Throughout Upper Cretaceous times—particularly during the Selbornian epoch—the Dartmoor granite contributed enormous quantities of detritus to the sediments of southern England, reaching as far afield as Kent and Oxfordshire, and perhaps farther The Cornish Pliocene was largely derived from the Cornish granites. The St. Keverne outlier is mainly derived from the Falmouth and Bodmin masses, and yields no evidence of Dartmoor detritus A number of new occurrences of dumortierite are recorded

Society of Public Analysts, April 3.—**L. H. Lampitt, E. B. Hughes, and H S. Rooke**: Furfural and diastase in heated honey Modifications of Fiehe's test and the aniline acetate test for furfural have been devised. If honey gives pronounced reactions with both of these tests it is probably adulterated, unless there is evidence that it has been strongly heated. Such honey has usually been found to be caramelised and unfit for use. Honey contains two diastatic enzymes, for it reacts with starch, yielding both dextrins and reducing sugars. If it is heated above 85° C. its diastatic activity is very rapidly destroyed—**J. W. Haigh Johnson**: Further notes on methods of sewage and water analysis; anti-oxidation and stabilisation of pollution Comparative results on river waters have shown that the Graph Standard method is much to be preferred to the Royal Commission's test. Three main types of biological oxidation curves are recognisable for polluted liquids. (1) Unstable type, characterised by very rapid, fairly uniform absorption of not more than five days' duration, followed by: (2) semi-stable type, having greatly diminished but very uniform oxidation rate, of indefinite duration, until: (3) nitrification supervenes From one-third to two-thirds of the chemically determined organic matter is recovered from sewage during purification without any appreciable absorption of oxygen. The effect of oxygen is apparently to oxidise unstable substances, whilst semi-stable substances are stabilised and precipitated as a relatively non-oxygen absorbing mud of increasing stability.—**B. J. F. Dorrington and A. M. Ward**: Potassium cyanate as a reagent for the detection of cobalt Potassium cyanate reacts with cobalt to form a blue complex The test, which is most sensitive when the reagent is used in alcoholic solution, will detect cobalt in a one-hundredth molar solution of cobalt nitrate.

EDINBURGH.

Royal Society, Mar. 4.—Hans Przibram: Quanta in biology. The movements of cold-blooded animals follow van 't Hoff's law; so also do many other processes of the living organism. It is suggested that the dissociation of ultimate particles to which the characteristics of life are attached is responsible for the exhibition of this phenomenon. A statistical conception which accounts for the decrease of the temperature coefficient with the raising of the temperature is developed. Przibram's work on the discontinuous growth of the Mantidæ and the conclusions of Koltzoff and Heidenham lead to an attempt to introduce a more systematic notion of fundamental quanta in biology.

PARIS

Academy of Sciences, Mar. 11.—R. Bourgeois: Concerning the programme of the expedition organised by the Bureau des Longitudes for the observation of the total eclipse of the sun of May 9, 1929. The station chosen for the observatory is the island of Bai-Kan: an outline of the scheme of observations proposed is detailed.—Jules Richard was elected *correspondant* for the Section of Geography and Navigation in the place of the late Roald Amundsen.—Jacob: Addition to the note "The application of the generalised integrals of Fourier to the calculus of probabilities."—A. Th. Masloff: An application of the theorem of Eisenhart.—Bertrand Gambier: Imaginary deformations of real surfaces: cyclic systems.—Marcel Vasseur: The relations between the two focal sheets of a rectilinear congruence.—C. Popovici: Functional equations and their parallelism with differential equations.—Georges Giraud: The solubility of the generalised problem of Dirichlet.—Georges Calugaréano: The calculation of the M exceptional values of integral functions of finite order.—Victor Vâlcovici: Generalisation of the theorem of Kœnig.—Benjamin Jekhowský: Calculation concerning the positions of the minor planets.—L. d'Azambuja: The structure of the solar chromosphere.—L. Driencourt: The choice of the projection to be adopted for aerial navigation maps.—Vasilesco Karpen: Demonstration of the relations of Maxwell-Clausius and of Clapyron.—S. Piña de Rubies: The arc spectrum of samarium. Measurements made at the normal pressure between 3100 A. and 2750 A.—Jean Savard: The ultra-violet absorption spectra of the ortho-, meta-, and para-cresols.—G. Jausseran: The evolution of the latent image. The relations between the density of the image and the time elapsed between the exposure and the development are shown graphically. The effects of the evolution of the latent image are considerable and must be taken into account in the photographic comparison of two non-simultaneous luminous intensities.—G. Athanasiu: The inversion of the photovoltaic effect by the OH and H ions.—Eugène Cornec and Henri Krombach: The ternary system: water, sodium nitrate, potassium nitrate. This system has been studied through a wide range of temperatures: a general outline of the results is given.—Horacio Damianovitch: The action of helium upon platinum. The product obtained by the action of helium upon platinum under the influence of a moderate electric discharge at low pressures presents properties clearly distinct from those of the metal itself, and it retains helium in a fairly stable form.—Ed. Bayle and L. Amy: The estimation of the hydrofluosilicic anion and that of fluorine in general.—Marcel Godchot and Mlle. Cauquil: The methylation of cycloheptanone. This ketone, treated with sodium amide and methyl iodide, gives rise to α, α-dimethyl-cycloheptanone and an α-methylcycloheptanone, the first being formed in relatively small quantity.—M. Battegay, H. Buser, and E. Schlager: A crystallised acetin and diglycide.—R. Cornubert and Ch. Borrel: Contribution to the study of the ketonic function.—Mlle. E. Jérémine and P. Fallot: The presence of a variety of jumillite in the neighbourhood of Calasparra (Province of Murcia).—Alberto Betim: The theory of Wegener in the light of some geological observations concerning Brazil.—G. Baeckeroot: The extension of the *Pierre de Stonne* in the Grand Duchy of Luxemburg.—Albert Michel Lévy: The existence of a level characterised by touchstones with Radiolaria at the base of the marine Carboniferous, in le Morvan.—M. Couvreur: The general structure of the shells of gastropods.—C. E. Brazier: Actinometric data for the region of Paris from measurements made at the Observatory of Parc Saint-Maur. The average quantity of heat received in one year by one square centimetre of the earth's surface in the climate of Paris is 93 large calories.—Marcel Mascré: New remarks on the fixation of the chondriome of the plant cell.—Guilliermond: New observations on the vital coloration by neutral red in plant cells.—Georges Montandon: An ape of anthropoid appearance in South America.—Ph. Joyet-Lavergne: The relations between metabolism and cytoplasmic sexualisation.—Raymond-Hamet: Tropine and atropine.—René Hazard and Michel Polonovski: The rôle of the tertiary amine function in the dipiperidine nucleus.—Raymond Poisson: *Paracoreomyces Thaxteri*, a parasite of *Stenocorixa protrusa*.—F. Diénert and P. Etrillard: The sterilisation of water by chlorine. The experiments described are opposed to the view that the sterilisation of contaminated water is due to an abiotic radiation, but are in agreement with the older hypothesis of direct action of the chlorine on the micro-organism.

GENEVA

Society of Physics and Natural History, Feb. 7.—Ed. Parejas: Geological observations in Corsica. (1) The Razzo Bianco near Venaco. The alpine dynamic metamorphism has determined in the limestone elements of the base of the nummulitic conglomerates of Venaco a fibrous texture of the calcite, and this is again met with in the limestones of Razzo Bianco. The latter must therefore have been marmorised during the Tertiary Alpine paroxysm. A later and weaker thrust has carried the Razzo Bianco limestones on to the granite.—R. Wavre: A new method in geodesy. The author shows that, starting with a method that he has given in his earlier communications, some important classical results of higher geodesy can be co-ordinated and new results obtained. This method consists essentially in employing a development in a convergent series where Laplace and Poincaré made use of a divergent development. Hence the method conforms to the desideratum formulated by Tisserand. The exact formula for the flattening is also given by M. Wavre.—W. Schopfer: Theoretical remarks on the question of the metabolism of the sexes. The author examines the old theory of the metabolism of the sexes (♀ anabolism and ♂ catabolism); he shows that if, when expressed too rigidly, it appears inexact, nevertheless modern researches give it some experimental support. The sexual metabolic differences occur even in the Mucorineæ, where the morphological differentiation of the sexes is scarcely noticeable.

VIENNA.

Academy of Sciences, Jan. 17.—A. Zinke and N. Schniderschitsch: Researches on perylene and its derivatives (22).—A. Pischinger and D. Boerner-

Patzelt The sarcosome problem. When the surviving thorax muscle of insects was observed fresh, there was no trace of granulations until Ringer's solution was run under the cover-glass But all sections of fixed insect thorax muscles showed sarcosomes —**H. Hahn** The integral concept.—**K. Menger** (1). The new definition of arc length —(2) A further generalisation of the concept of length.

Jan 24 —**A. Tornquist** The perimagmatic lead-copper-silver-zinc ore deposits from Offberg in the Remschnigg.—**L. Kober** The Salzberg of Hallstatt.

WASHINGTON, D C

National Academy of Sciences (*Proc.*, Vol. 15, No. 1, Jan. 15) —**Arthur G Scroggie** and **George L. Clark.** The crystal structure of anhydrous silicotungstic acid and related compounds, and their probable molecular formulæ Acids with 7, 8, and 10 tungsten atoms have been isolated Those with 8, 10, and 12 tungsten atoms crystallise as body centred cubes, there being a central stabilising SiO_4 group.—**Wilder D Bancroft** and **H. L. Davis** Binary solutions of consolute liquids.—**Herbert J. Brennen**. A new equation of state. A mathematical development of van der Waals' equation.—**Duncan A. MacInnes** and **Irving A Cowperthwaite**. The effect of diffusion at a moving boundary between two solutions of electrolytes In measuring the transfer number of an electrolyte by timing the moving boundaries, interrupting the current for periods up to 30 min has no effect on the results. The boundary fades away, but gradually reappears on switching on the current. Diffusion occurs, but the potential gradient set up quickly restores the sharp boundary —**Carl Barus** · Adiabatic expansion in case of vanishing increments —**Paul S. Bauer**: The condition of self-oscillation of a general triode system A mathematical discussion.—**Benedict Cassen**. On the symmetry of protonic wave functions —**W. Uyterhoeven** Positive ion currents in the positive column of the glow-discharge in the noble gases.—**E L Kinsey**: Note on the *D* line excitation by the green sodium band and the dissociation potential of sodium vapour (see NATURE, June 9, 1928, p. 904) —**Einar Hille** and **J. D. Tamarkin** On the summability of Fourier series (Second note) —**H S. Vandiver** Summary of results and proof concerning Fermat's last theorem (Third paper) —**Dietrich C. Smith** · The direct effect of temperature changes upon the melanphores of the lizard *Anolis equestris* Between 8° and 43° C. their behaviour in isolated pieces of skin is controlled by illumination Outside these limits, cold generally produces 'expansion,' and further heat 'contraction,' independently of illumination —**Henry B. Ward**. Further studies on the influence of a power dam in modifying conditions affecting the migration of the salmon Sockeye salmon migrating up the Baker River seem to avoid the fish ladder provided at the dam, possibly owing to some bad quality of the water. The down-stream movement of young sockeyes seems to be decreasing, they may be forming a physiologically landlocked race in the artificial lake caused by the power dam —**David I. Macht** · Pharmacological synergism of stereoisomers. When the effect of a combination of two or more drugs is different from the added effects of the separate drugs, this is termed synergism. Many drugs show the effect The different optical forms of nicotine, epinephrin, camphor, hyoscyamin, hyoscin, quinin, and cinchonin were tested. Generally the combination of an optical pair gives a much greater effect than either separately. If animal or plant cells have receptor groups of a lævo and dextro type, mixtures of optical pairs have two points of attack, thus accounting for the effect.

Official Publications Received.

BRITISH

Report of the Department of Industries, Madras, for the Year ending 31st March 1928 Pp vii+103 (Madras Government Press) 12 annas

Journal of the Indian Institute of Science Vol 11A, Part 19 i Contributions to the Study of Spike-Disease of Sandal (*Santalum album*, Linn), Part 4 Chemical Composition of Healthy and Spiked Sandal Stems, by D A Rama Rao and M Sreenivasaya, ii Contributions to the Study of Spike-Disease of Sandal (*Santalum album*, Linn), Part 5 Transmission of Spike by Budding, by M Sreenivasaya and G. Gopalaswami Naidu Pp 241-247+8 plates (Bangalore) 1 rupee

Legislative Assembly (Second Session), New South Wales Report of the Director General of Public Health, New South Wales, for the Year 1927 Pp vi+208 (Sydney, N S W Alfred James Kent) 10*s*

The Scientific Proceedings of the Royal Dublin Society Vol 19, N S, Nos 14 18 14 On the Structure of *Palæacis*, by Dr Louis B Smyth, 15 William Higgins, a Pioneer of the Atomic Theory, by Dr J Reilly and D T MacSweeney, 16 The Integration of Light by Photo-electrolysis, by Dr W R G Atkins and Dr H H Poole, 17 A Note on Gas Analysis, by James T Donnelly, C Hamilton Foott and Dr J Reilly, 18 The Photo-electric Measurement of the Illumination in Buildings, by Dr W R G Atkins and Dr H H Poole Pp 125 188+plates 6-8 (Dublin Hodges, Figgis and Co, London Williams and Norgate, Ltd) 5*s*.

The Realist a Journal of Scientific Humanism Published for the Realist Publishing Co, Ltd Vol 1, No 1, April Pp 192 (London Macmillan and Co, Ltd) 2*s* net

Far Eastern Association of Tropical Medicine Transactions of the Seventh Congress held in British India, December 1927 Edited by Lieut-Col J Cunningham Vol 1 Pp xl+865+61 plates (Calcutta. Thacker's Press and Directories, Ltd)

Transactions of the Optical Society Vol 30, No 2, 1928-29 Pp iv+49-100 (London)

The Institute of Physics List of Members, January 1, 1929 Pp 24 (London)

Transactions of the Rochdale Literary and Scientific Society, with a Record of the Proceedings of the Jubilee Celebrations Vol 16, 1926-1928 Pp 128+xlvi (Rochdale)

Journal of the Chemical Society containing Papers communicated to the Society March Pp iv+357 589+x (London)

Report of the Marlborough College Natural History Society for the Year ending Christmas, 1928 (No 77) Pp 84+8 plates (Marlborough) 5*s*, to Members, 3*s*

Transactions of the Royal Society of Edinburgh Vol 16, Part 1, No 8 The Oogenesis of Carcinas mœnas Penn, with special reference to Yolk Formation By L A Harvey Pp 157-174+2 plates (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd) 3*s*

Commonwealth of Australia Council for Scientific and Industrial Research Pamphlet No 10 The Health and Nutrition of Animals Reports by Sir Arnold Theiler and Dr J B Orr Pp 76 Bulletin No. 40 Observations on the Hydatid Parasite (Echinococcus granulosus) and the Control of Hydatid Disease in Australia By I Clunies Ross. Pp 63 (Melbourne H J Green)

The Indian Forest Records Entomology Series, Vol 13 Part 6 On some New Indian Coleoptera, Hemiptera and Thysanoptera Part i Neue Indische Lycidae, nebst faunistischen Bemerkungen (Lycidae, Col), von R Kleine, Part ii A new Agrilus from India (Buprestidae, Col), by A Thery, Part iii New Species of Cicadidae and Fulgoridae from India and Burma (Hemip), by O C Ollenbach, Part iv A new Subgenus and Species of Tingis from Burma (Tingitidae, Hemip), by Carl J Drake; Part v New Thysanoptera from India, by Dudley Moulton Pp iii+48+5 tafeln+2+12+1 plate+2+8 (Calcutta Government of India Central Publication Branch) 1 6 rupees, 2*s* 3*d*

Department of the Interior, Canada Topographical Survey Bulletin No 60 A Study of the Dominion Standard Yard and other Standards of Length By R H Field Pp 40 (Ottawa F A Acland)

Rhodesia Museum, Bulawayo Twenty-seventh Annual Report, 1928. Pp 14 (Bulawayo)

FOREIGN

The Science Reports of the Tôhoku Imperial University, Sendai, Japan Fourth Series (Biology), Vol 4, No 1, Fasc 1 Pp 182+11 plates. (Tokyo and Sendai Maruzen Co, Ltd)

Journal of the Faculty of Science, Imperial University of Kyoto Section 4, Zoology, Vol 1, Part 5 Studies on the Calcareous Sponges of Japan By Prof Sanji Hōzawa. Pp 277-389+plates 12 23 (Tokyo Maruzen Co, Ltd) 8 00 yen

Scientific Papers of the Institute of Physical and Chemical Research No 177 Experimental Studies on Form and Structure of Sparks, Part 5 By Torahiko Terada, Ukitiro Nakaya and Ryûzô Yamamoto Pp 43-68+18 plates 70 sen No 178 Katalizeca malkombiniĝo de karbono unuoksida 1 Fero kiel katalizanto De Hirosi Tutiya Pp 69-82+plate 19 30 sen No 179 Untersuchung der Dekahydrochinolderivate 5 Mitteilung Synthese des trans-o-Dimethylamido-n-propyl-cyclohexans und die Wasserspaltung des o-n-Propyl-cyclohexanols Von Shin-ichiro Fujise Pp 83-89 20 sen No 180 Physico-chemical Studies on Bioluminescence 7 The Solubility of Cypridina Luciferin in Organic Solvents By Sakyo Kanda Pp 91-98 15 sen No 181 Stark Effect of Helium 2P-6D line by Quantum Mechanics By Yoshio Fujioka Pp. 99-106+plate 20 25 sen (Tōkyō Iwanami Shoten)

Department of Commerce Bureau of Fisheries Bureau of Fisheries

249-337 (Washington, D C. Government Printing Office) 25 cents

United States Department of Agriculture Technical Bulletin No 77 The Host Plants of the European Corn Borer in New England By Benjamin E Hodgson Pp 64 (Washington, D C Government Printing Office) 30 cents

Observations and Investigations made at the Blue Hill Meteorological Observatory in the Year 1928 under the direction of Prof Alexander McAdie Pp 29+36 plates (Cambridge, Mass)

University of California Publications in American Archaeology and Ethnology Vol 25, No 2 Mentawei Religious Cult By Edwin M Loeb Pp 185 247+plates 69-73 80 cents Vol 25, No 3 Tribal Initiations and Secret Societies By Edwin M Loeb Pp 249-288 50 cents (Berkeley, Calif University of California Press, London Cambridge University Press)

Deutsche Seewarte Aus dem Archiv der Deutschen Seewarte Band 46, Nr 3 Gezeitenuntersuchungen in der Deutschen Bucht der Nordsee Nach Beobachtungen an Bord des Vermessungsschiffes *Panther* im Juni 1924 Im Auftrage der Deutschen Seewarte bearbeitet von Dr H Thorade Pp 85+4 Tafeln (Hamburg)

Department of Commerce Bureau of Standards Research Paper No 45 Apparatus and Methods for the Separation, Identification and Determination of the Chemical Constituents of Petroleum By Edward W Washburn, Johannes H Bruun and Mildred M Hicks Pp 467-488+5 plates 10 cents Research Paper No 46 Recombination Spectra of Ions and Electrons in Cæsium and Helium By F L Mohler and C Boeckner Pp 489 500 5 cents Research Paper No 49 Discharge Coefficients of Square edged Orifices for Measuring the Flow of Air By H S Bean, E Buckingham and P S Murphy Pp 561-658+2 plates 20 cents (Washington, D C Government Printing Office)

Proceedings of the United States National Museum Vol 74, Art 13 Tschermigite, Ammoniojarosite, Epsomite, Celestite and Paligorskite from Southern Utah By Earl V Shannon (No 2758) Pp 12 Vol

(No 2766) Pp 10 Vol 74, Art 24 Notes and New Species of American Moths of the Genus Scoparia Haworth By Harrison G Dyar (No 2769) Pp 9 Vol 74, Art 25 A New Salamander from Southern California By Emmett Reid Dunn (No 2770) Pp 3 (Washington, D C Government Printing Office)

Diary of Societies.

FRIDAY, April 19

Physical Society (at Imperial College of Science), at 5 —Presentation of the Guthrie Medal to Dr C E Guillaume —Prof W R Bridgman The Properties of the Elements under High Pressures (Guthrie Lecture)

British Institute of Radiology (Medical), at 5 —Informal Discussion on Bone-Diseases (especially Multiple Myeloma)

Institution of Mechanical Engineers, at 6 —W Reavell The Standardisation of Keys and Keyways

Institution of Electrical Engineers (London Students' Section) (Annual General Meeting), at 6 15 —V E Connor The Manufacturing and Testing of Submarine Cables

Royal Photographic Society of Great Britain, at 7 —B Chambers and F W Sharp Carbon and Carbro

Society of Dyers and Colourists (Glasgow Section) (at 7 Gordon Street, Glasgow), at 7 15 —Annual General Meeting

West Bromwich Engineering Society (at Kenrick Technical College, West Bromwich), at 7 30 —D G Mackintosh The Erection of Steel Bridges

Junior Institution of Engineers, at 7 30 —Lt -Col J T C Moore-Brabazon Early Aviation (Lecture).

Institute of British Foundrymen (Sheffield Branch) (Annual Meeting) (at Albany Hotel, Sheffield), at 7 45 —Recent Developments in Cupola Control

Royal Society of Medicine (Electro-Therapeutics Section), at 8 30 —Dr S G Scott Myeloma—Differential Diagnosis —Dr J D White Bone Lesions in Tropical Diseases

Royal Institution of Great Britain, at 9 —Prof Owen T Jones History of the Grand Canyon, Yellowstone National Park

Society of Dyers and Colourists (Manchester Section) (at Manchester) —Annual General Meeting

SATURDAY, April 20

Institution of Municipal and County Engineers (Southern District) (at Council House, Bristol), at 10 30 A M —H F Proctor Description of the New Power Station Portishead

North of England Institute of Mining and Mechanical Engineers (Newcastle-upon-Tyne), at 2 30 —C H Leeds Boring against Workings likely to contain an Accumulation of Water or other Liquid Matter, and a Method of Negotiating a Fault —C N Kemp The X-Ray Analysis of Coal the Radiographic Variables and their Control —Papers open for discussion —Roof Control on Longwall Faces L E G

ground, Smyth, Land Drainage, H C Motion of Particles in a Fluid, R G Lunnon

Mining Institute of Scotland (at Royal Technical College, Glasgow) Annual Meeting

MONDAY, April 22

Royal Geographical Society (at Lowther Lodge), at 4.—Miss E R G Taylor Roger Barlow an Early XVIth Century Geographer

Victoria Institute, at 4 30 —Dr A T Schofield Humanity

Institution of Mechanical Engineers (Graduates' Section, London), at 6 30 —Informal Discussion on The Engineer as a Salesman

Institution of Automobile Engineers (Graduates' Meeting) (at Loughborough College), at 7 —H M Smith Steering Gears

Institution of Automobile Engineers (North of England Centre) (at Sheffield University), at 7 —Dr H J Gough Recent Developments in the Study of the Fatigue of Metals

Royal Photographic Society of Great Britain (Informal Meeting of Kinematograph Group), at 7 —H A Carter. The De Vry 16 mm Synchronised Sound Motion Picture Apparatus, with Projection of Films and Synchronised Gramophone Records

Royal Institute of British Architects, at 8 —J Begg The Work of George Wittet.

Royal Society of Arts, at 8 —Sir E Denison Ross Nomadic Movements in Asia (Cantor Lectures) (II)

Royal Society of Medicine (Odontology Section), at 8 —G Northcroft The Migration of a Foreign Body —S Friel The Relation of Function to the Size and Form of the Jaws

Royal Geographical Society (at Polytechnic, Regent Street), at 8 30 —G M Dyott The Search for Col Fawcett (with Kinematograph Films)

TUESDAY, April 23

Royal Society of Medicine (Medicine Section), at 5 —Dr O Leyton How can we decide whether a case of Glycosuria should be treated?—Dr W T Munro Pulmonary Tuberculosis due to Bovine Tubercle Bacilli

Zoological Society of London, at 5 30 —Secretary (*a*) Report on the Additions to the Society's Menagerie during the month of March 1929, (*b*) Exhibition and Note on the Society's Scientific Publications —S G M Ramanujam The Study of the Development of the Vertebral Column in Teleosts, as shown in the Life history of the Herring —Prof E B Poulton British Insectivorous Bats and their Prey

Institution of Civil Engineers, at 6

London Natural History Society (at Winchester House, E C) (Bacot Memorial Meeting), at 6 30 —R S Bagnall Plants and their Insect Associates

Royal Photographic Society of Great Britain, at 7 —H R Ward Some Continental Zoos

Institution of Automobile Engineers (Wolverhampton Centre) (at Engineering and Scientific Club, Wolverhampton), at 7 30 —H W Pitt Central Lubrication of Chassis Bearings

WEDNESDAY, April 24

Eugenics Society (at Royal Society), at 5 15 —C J Bond Hemilateral Asymmetry in Animals and Man, and its Relation to Cross-breeding (Lecture)

Newcomen Society for the Study of the History of Engineering and Technology (at Caxton Hall), at 5 30 —C F Dendy-Marshall The Rainhill Locomotive Trials of 1829

Geological Society of London, at 5 30 —R Murray-Hughes The Geology of Part of North-Western Rhodesia, with Petrographical Notes by A A Fitch

Royal Society of Arts, at 8 —Lynton Fletcher Recent Developments in Educational Broadcasting

THURSDAY, April 25

London Mathematical Society (at Royal Astronomical Society), at 5 —S D Chowla Some Formulæ Connected with Gauss's Sums —Doris M Hirst On Expansions which are Formally Reduced to Zero by the Operator Sinh $D-cD$ —Prof E W Hobson On a Generalisation of Watson's Expressions for Legendre's Functions —Prof R L Jeffery The Continuity of a Function Defined by a Definite Integral —J Tennant Nasik or Pandiagonal Squares of the Order of any Odd Prime

Institute of Pathology and Research (St Mary's Hospital, W 2), at 5 —Sir Almroth E Wright The Experimental Method in Medicine

Chemical Society (at Institution of Mechanical Engineers), at 5 30 —Sir Harold Hartley Theodore W Richards Memorial Lecture

Royal Society of Medicine (Urology Section), at 5 30 —Dr P J Cammidge Prostatectomy in Diabetics

Institution of Electrical Engineers, at 6 —Dr G C Simpson Lightning (Kelvin Lecture)

Royal Aeronautical Society (at Royal Society of Arts), at 6 30 —Squadron-Leader C L Scott By Flying Boat to India

FRIDAY, April 26

Physical Society (at Imperial College of Science), at 5 —T Smith, Dr G F C Searle, Instructor-Capt T Y Baker, Dr J W French, W E Williams, C G Vernon, H H Emsley, C W Hansel, H Tunley, L Moore, Conrad Beck, V T Saunders, and Dr C V Drysdale Discussion on The Teaching of Geometrical Optics

Royal Society of Medicine (Disease in Children Section), at 5

Royal Institution of Great Britain, at 7 —E A Salt Platinotype

Institution of Electrical Engineers (Scottish Centre) (at University College, Dundee), at 7 30 —W Holmes Load-levelling Relays and their Application in connexion with Future Metering Problems

Royal Society of Medicine (Epidemiology Section), at 8 —Dr J G Thomson Endemic Malaria in Southern Rhodesia

British Psychological Society (Industrial Section) (at National Institute of Industrial Psychology), at 8 —J N Langdon Evidence of a Central Factor in Tests of Manual Dexterity

Royal Institution of Great Britain, at 9 —Prof R W Chambers English Civilisation from Alfred to Harold, 900-1066

PUBLIC LECTURES.

MONDAY, April 22

The University, Glasgow, at 5 —Sir Norman Walker Medical Education and Qualification in the United States

TUESDAY, April 23

Gresham College (Basinghall Street), at 6 —A R Hinks Latitudes and Longitudes (Gresham Lectures) (Succeeding Lectures on April 24, 25, and 26)

Institution of Mechanical Engineers, at 8 —C E Stromeyer What Health and Civilisation owe to Engineering (Chadwick Lecture)

WEDNESDAY, April 24

University of Birmingham, at 4 30 —Dr C Singer Epochs of Medical History (Succeeding Lectures on May 1 and 8, June 19 and 26)

Mansion House (arranged by British Science Guild), at 4 30 —Developments of British Chemical Manufactures Lord Melchett in the chair —Sir Frederick Keeble Fertilisers from the Air —A B Shearer Rayon (Artificial Silk) —F H Carr Synthetic Drugs

FRIDAY, April 26

World Association for Adult Education (16 Russell Square, W C 1), at 8 30 —Miss R M Fleming Soil and Civilisation in Russia

SATURDAY, APRIL 27, 1929.

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Editorial and Publishing Offices:
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The Smithsonian Institution and Scientific Education.

SINCE the last Report of the Smithsonian Institution was published, a new secretary, Dr. Charles G Abbot, Director of the Astrophysical Observatory, has been appointed, and the Report to June 30, 1928, appears over his signature. It is impossible in these columns to mention, far less to do justice to, the manifold activities of this wonderful institution, with its great museums of science and of art, its zoological park, its astronomical observatory, and its international exchange service But the new secretary, in virtue of his appointment, has felt it to be his duty to make a wide survey of the activities of "the Smithsonian," in order to gain some knowledge of the most effective ways in which it may advance the mission of its founder, James Smithson, "for the increase and diffusion of knowledge amongst men"

Dr Abbot's conclusions are of great interest, and since they are of general application, deserve wide attention He points out that, to the casual observer, it may appear that the most important function of the Smithsonian is the administration of the national museum, art galleries, and zoological park confided to its direction The educational value of these is great, but a closer analysis would show that their influence is largely confined to the neighbouring States, and that a lessening of influence, which increases rapidly with distance, affects more distant States and foreign countries.

On the other hand, to be contrasted with this relatively local influence, is the wider reach of the International Exchange Service, as associated with the publications of the Institution Reviewing the whole field, Dr. Abbot is led to the conclusion that the care of the public exhibits, educational and interesting though they are, is after all not the greatest duty of the Smithsonian Institution. In his view its main services to science are:

"In the collection of new specimens, which the passage of a few more years might prevent for ever, in the study of existing national collections to unlock the treasures of knowledge which they certainly contain, in the promotion of researches growing out of our expert experience in the field of radiation, in the publication of knowledge in both technical and popular forms; and in the wide diffusion of knowledge through exchanges and correspondence in all these lines, activities entirely suited to the genius and situation of the Smithsonian, which in their world-wide application and future promise, outrank in value the more local influence of the public exhibitions."

The one thing that is lacking to promote these

researches on the scale they deserve is, the impecunious institutes of Britain will learn with a shock of sympathy, lack of adequate means.

Put broadly, Dr. Abbot's view rather sounds like pitting against one another the advance of technical knowledge and the scientific education of the people, the latter of which is bound in the end to be more local in its development, since the less educated a person may be the more he must depend on sense impressions and the less on the mental stimulus of the written word; and the Smithsonian plumps heavily for the former Now we are not convinced that the contrast is a necessary one, since if both the scientific education of the people and the advance of technical scientific knowledge are essential, it can scarcely be said that one is of more value than the other. Both are necessary ingredients in the sum of scientific advancement.

If science is to make the progress it deserves, it must be upon the basis of a wide sympathy and understanding amongst the plain men of the earth At the lowest terms of this compact, research can obtain the adequate funds which the Smithsonian and every other scientific institution longs for, only when the public has grasped the vital importance of scientific results so thoroughly that it compels the disbursement for such purposes of the State funds which it itself contributes. In other words, in these democratic days, the adequate prosecution of research is inextricably bound up with the scientific education of the people

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Science and Humanism.

THE neglect of science by historians, and the misunderstanding of its service by representatives of labour, are familiar to most readers of NATURE. The new review *The Realist*, to which reference was made in our issue of April 6, p. 540, contains two contributions dealing respectively with these subjects—one by Dr Singer on scientific humanism and the other by Mr. John Gibson on the relations of labour and science. Both describe from different points of view a state of things which our readers would wish to alter: both resolve themselves ultimately into a question of education.

Dr Singer starts with the astounding fact, often commented on in these columns, that our accustomed books on history, even such monumental works as the "Cambridge Modern History," ignore, for the most part completely, the rôle played by science in the historic process. As he says—and it is a new way of putting it—"Had it so fallen out that Galileo and Kepler, Newton and Lavoisier and Darwin had been Persians, Turks, Indians, and Russians instead of Italians, Germans, Frenchmen, and Englishmen, it is very certain that the face of the civilised world would have been quite different from what it is Yet such names are wellnigh ignored in ordinary works of history" The 'ordinary' historian, when charged with this, says either that history is past politics, or how men have come to live together more or less peacefully in States, or, if he does not subscribe to this narrow and exploded heresy, that he does not know about science and thinks it better to leave it to those who do The latter argument, however, is not applicable to such a work as the "Cambridge Modern History," which is a composite production and might just as well contain chapters on science as it does certain chapters on literature

The right solution is one which will take years of philosophic thinking to achieve, namely, what is the place which science has taken in building up the social structure which is, as most of the historians now perceive, the proper subject of history. Dr Singer therefore seems to us perfectly right in laying more stress on the introduction of science in its proper place in the presentation of general history than on the elaboration of the historic side in the teaching of science, though that also is a good thing.

The article by Mr. Gibson, on science and labour, is more depressing and raises another educational question of a wider kind Mr Gibson notes the almost complete absence of any knowledge or interest in science among the workmen whom he has met, and also finds dread and opposition to the spread of machinery as displacing the human worker He is probably generalising from the class of workmen—those in the building trades—who suffer most immediately from the introduction of new machines and have the least turn for mechanics. The picture would not be so black if it were painted of any branch of the engineers. So far as the educational question is concerned, it should be easier rather than more difficult to imbue the young workman with some knowledge and interest in science than his more lettered fellow-scholar who gives so much time to literature and the study of the dead languages. The boy who goes to a technical or a central school with an industrial bias—and these places are growing—has a good opportunity of approaching science at least on the practical side, and Mr. Gibson's account of the young man of to-day who does all

the needed repairs to his motor bicycle or his wireless set, inspires one with some hope. It is, of course, precisely by that channel that the intelligent teacher of science will approach the theoretical basis

On the question of the displacement of the man by the machine, Mr. Gibson is dealing with a problem of social and economic organisation which has been with us all through the Industrial Revolution It cannot be said that we have dealt with it very wisely or successfully, and yet we are all agreed that operations which can be as efficiently performed by a machine should, in the interest alike of production and the producer, be so done. Every displacement, however, should be accompanied by careful provision for the displaced The social *raison d'être* of the machine is that it frees the human agent for other work, either in the further conquest of Nature or the development of his own faculties

Srinivasa Ramanujan.

Collected Papers of Srinivasa Ramanujan Edited by G H Hardy, P. V. Seshu Aiyar and B. M. Wilson. Pp xxxvi + 355. (Cambridge: At the University Press, 1927) 30*s*. net

RAMANUJAN was born in India in December 1887, came to Trinity College, Cambridge, in April 1914, was ill from May 1917 onwards, returned to India in February 1919, and died in April 1920. He was a fellow of Trinity and a fellow of the Royal Society.

Ramanujan had no university education, and worked unaided in India until he was twenty-seven years of age. When he was sixteen he came by chance upon a copy of Carr's "Synopsis of Mathematics", and this book, now sure of an immortality its author can scarcely have dreamt of, woke him quite suddenly to full activity. A study of its contents is indispensable to any considered verdict upon Ramanujan. It gives a very full account of the purely formal side of the integral calculus, containing, for example, Parseval's formula, Fourier's repeated integral, and other 'inversion formulæ'. There is also a section on the transformation of power series into continued fractions. Ramanujan somehow acquired also an effectively complete knowledge of the formal side of the theory of elliptic functions (not in Carr). The matter is obscure, but this, together with what is to be found in, say, Chrystal's "Algebra", seems to have been his complete equipment in analysis and theory of numbers It is at least certain that he knew nothing of operations with divergent series or of work on the distribution of primes Above all, he was totally ignorant of Cauchy's theorem and complex function-theory

The work he published during his Indian period did not represent his best ideas, which he was probably unable to expound to the satisfaction of editors. In the beginning of 1914, however, a letter from Ramanujan to Mr Hardy (then at Trinity, Cambridge) gave unmistakable evidence of his powers, and he was brought to Trinity, where he had three years of health and activity.

I do not propose to discuss here in detail the work for which Ramanujan is solely responsible (a very interesting estimate is given by Prof. Hardy, p xxxiv) If we leave out of account for the moment a famous paper written in collaboration with Hardy, his definite contributions to mathematics, substantial and original as they are, must, I think, take second place in general interest to the romance of his life and mathematical career, his unusual psychology, and, above all, to the fascinating problem of how great a mathematician he might have become in more fortunate circumstances. In saying this, of course, I am adopting the highest possible standard, but no other is appropriate.

Ramanujan's great gift is a 'formal' one; he dealt in 'formulæ' As a specimen we may take the following (which no one can ever resist quoting) If $p(n)$ is the number of ways of expressing n as a sum of positive integers ('partitions of n'), then

$$p(4)+p(9)x+p(14)x^2+p(19)x^3+\ \ldots \\ =5\frac{\{(1-x^5)(1-x^{10})(1-x^{15})\ \ldots\}^5}{\{(1-x)(1-x^2)(1-x^3)\ \ldots\}^6}.$$

The great day of formulæ, however, is over. No one, if we are again to take the highest point of view, seems able to discover a radically new type, though Ramanujan comes near it in his work on partition series. A hundred years or so ago his powers would have had ample scope Discoveries alter the general mathematical atmosphere and have very remote effects, and we are not prone to attach great weight to rediscoveries, however independent they seem. How much are we to allow for this; how great a mathematician might Ramanujan have been 100 or 150 years ago, what would have happened if he had come into touch with Euler at the right moment? How much does lack of education matter? Was it formulæ or nothing, or did he develop in the direction he did only because of Carr's book—after all, he learned later to do new things well, and at an age mature for an

Indian? Such are the problems Ramanujan raises, and everyone has now the material to judge them. The letters and the lists of results announced without proof are the most valuable evidence; indeed, they suggest that the 'note-books' would give an even more definite picture of the essential Ramanujan, and it is very much to be hoped that the editor's project of publishing them *in extenso* will eventually be carried out.

Carr's book quite plainly gave Ramanujan both a general direction and the germs of many of his most elaborate developments But even with these partly derivative results one is impressed by his extraordinary profusion, variety, and power There is scarcely a field of formulæ that he has not enriched, and in which he has not revealed unsuspected possibilities. The beauty and singularity of his results are entirely uncanny. Are they odder than one would expect things selected for oddity to be? The moral seems to be that we never expect enough; the reader at any rate experiences perpetual shocks of delighted surprise. Prof Watson and Mr. Preece have begun the heroic task of working through the unproved statements, some of their solutions have appeared recently in the *Journal of the London Mathematical Society*, and these strongly encourage the opinion that a complete analysis of his note-books will prove very well worth while

There can, however, be little doubt that the results showing the most unmistakable originality and the deepest insight are those on the distribution of primes (see pp xxii-xxv, xxvii, 351, 352). The problems here are not in origin formal at all; they concern approximative formulæ for such things as the number of primes, or of integers expressible as the sum of two squares, less than a large number x; and the determination of the order of the errors is a major part of the theory. The subject has a subtle function-theory side, it was inevitable that Ramanujan should fail here, and that his methods should lead him astray, he predicts the approximative formulæ, but is quite wrong about the orders of the errors These problems tax the last resources of analysis, took more than a hundred years to solve, and were not solved at all before 1890; Ramanujan could not possibly have achieved complete success. What he did was to perceive that an attack on the problems could at least be begun on the formal side, and to reach a point at which the main results became plausible The formulæ do not in the least lie on the surface, and his achievement, taken as a whole, is quite extraordinary.

If Carr's book gave Ramanujan direction, it had at least nothing to do with his *methods*, the most important of which were completely original His intuition worked in analogies, sometimes very remote, and to an astonishing extent by empirical induction from particular numerical cases Lacking Cauchy's theorem, he naturally dealt much in transformations and inversions of order of double integrals But his most important weapon seems to have been a highly elaborate technique of transformation by means of divergent series and integrals. He had no strict logical justification for his operations He was not interested in rigour, which for that matter is of secondary importance in analysis, and can be supplied, given the real idea, by any competent professional The clear-cut idea of what is *meant* by a proof, nowadays so familiar as to be taken for granted, he perhaps did not possess at all If a significant piece of reasoning occurred somewhere, and the total mixture of evidence and intuition gave him certainty, he looked no further It is a minor indication of his quality that he can never have *missed* Cauchy's theorem With it he would have arrived more rapidly and conveniently at some of his results, but his own methods enabled him to survey the field with an equal comprehensiveness and as sure a grasp

I must say something finally of the paper on partitions (pp 276-309), written jointly with Hardy. The number $p(n)$ of partitions of n increases rapidly with n; thus

$$p(200) = 3972999029388$$

The authors show that $p(n)$ is the integer nearest to

$$(1) \qquad \frac{1}{2\sqrt{2}} \sum_{q=1}^{\nu} \sqrt{q}\, A_q(n) \psi_q(n),$$

where $A_q(n) = \Sigma \omega_{p,q} e^{-2np\pi i/q}$, the sum being over p's prime to q and less than it, $\omega_{p,q}$ is a certain $24q^{th}$ root of unity, ν is of the order of $\sqrt{n}$, and

$$\psi_q(n) = \frac{d}{dn} \left(\exp\{C\sqrt{(n - \tfrac{1}{24})}/q\}\right), \quad C = \pi\sqrt{(\tfrac{2}{3})}$$

We may take $\nu = 4$ when $n = 100$. For $n = 200$ we may take $\nu = 5$, five terms of the series (1) predict the correct value of $p(200)$. We may always take $\nu = \alpha\sqrt{n}$ (or rather the nearest integer), where α is any positive constant, provided n exceeds a value $n_0(\alpha)$ depending only on α.

The reader does not need to be told that this is a very astonishing theorem, and he will readily believe that the methods by which it was established involve a new and important principle, which has been found very powerful and fruitful in other fields The story of the theorem is a romantic one. (To do justice to it I must infringe a little the rules

about collaborations; I therefore add that Prof. Hardy confirms and permits my statements of bare fact.) One of Ramanujan's Indian conjectures was that the first term of (1) was a very good approximation to $p(n)$; this was established without great difficulty. At this stage the $n-\frac{1}{24}$ was represented by a plain n—the distinction is irrelevant. From this point the real attack begins. The next step in development, not a very great one, was to treat (1) as an 'asymptotic' series, of which a fixed number of terms (*e.g.* $\nu=4$) were to be taken, with an error of the order of the next term.

From now to the very end Ramanujan always insisted that much more was true than had yet been established: "there must be a formula with error $O(1)$." This was his most important contribution; it was both absolutely essential and most extraordinary. A severe numerical test was now made, which elicited the astonishing facts about $p(100)$ and $p(200)$. Then ν was made a function of n: this *was* a very great step, and involved new and deep function-theory methods that Ramanujan obviously could not have discovered by himself. The complete theorem thus emerged.

The solution of the final difficulty was probably impossible, however, without one more contribution from Ramanujan, this time a perfectly characteristic one. As if its analytical difficulties were not enough, the theorem was entrenched also behind almost impregnable defences of a purely formal kind. The form of the function $\psi_q(n)$ is a kind of indivisible unit; among many asymptotically equivalent forms it is essential to select exactly the right one. Unless this is done at the outset, and the $-\frac{1}{24}$ (to say nothing of the d/dn) is an extraordinary stroke of formal genius, the complete result can never come into the picture at all. There is, indeed, more than a touch of real mystery. If only we *knew* there was a formula with error $O(1)$, we might be forced to the correct form of ψ_q. But why was Ramanujan so certain there was one? *Theoretical* insight, to be the explanation, had to be of an order scarcely to be credited. Yet it is hard to see what numerical instances could have been available to suggest so strong a result; and unless the form of ψ_q were known already, *no* numerical evidence could suggest anything of the kind—there seems no escape, at least, from the conclusion that the discovery of the correct form was a single stroke of insight. We owe the theorem to a singularly happy collaboration of two men, of quite unlike gifts, in which each contributed the best, most characteristic, and most fortunate work that was in him. Ramanujan's genius did have this one opportunity worthy of it.

The volume contains a biography by the second of the editors, and the obituary notice by Prof. Hardy. These give a vivid picture of Ramanujan's interesting and attractive personality. The mathematical editors have done their work most admirably. It is very unobtrusive, the reader is told what he wants to know at exactly the right moment, and more thought and bibliographical research must have gone into it than he is likely to suspect. J. E. LITTLEWOOD.

Filterable Viruses

Filterable Viruses. By Harold L. Amoss, Jacques J. Bronfenbrenner, Alexis Carrel, Edmund V. Cowdry, Rudolf W. Glaser, Ernest W. Goodpasture, Louis O. Kunkel, Stuart Mudd, Peter K. Olitsky, Thomas M. Rivers. Edited by Thomas M. Rivers. Pp. ix + 428 + 15 plates. (London: Baillière, Tindall and Cox, 1928.) 34*s.* net.

THE nature of 'virus' still eludes precise definition. No one knows exactly what it is, and none of the hypotheses covers all the apparent facts without a certain amount of artificial straining. At one extreme there is the conception that a virus is a parasite, something analogous in a general way, though not necessarily closely similar to a bacterium or a protozoon, with properties appropriate to its very small size. It is odd, though, if this is so, that no saprophytic virus is known. We can imagine a pathogenic bacterium arising by some process of adaptation from the many similar saprophytes existing everywhere in Nature, but the viruses are always associated with living cells and have never been certainly known to multiply in their absence. At the other extreme are those who look upon them as derivatives of the cells with which they are associated, possibly particulate but not living individual organisms. The difficulty in this view is to explain the transmissibility, the remarkable power of multiplication or increase, and the specificity revealed by serological reactions.

Midway between these extremes come those who, like Boycott, regard viruses as an order of being neither wholly alive nor wholly dead, but with some of the properties of both states; or, like Wollman, look upon them as altered detachable genes, capable of leaving their cells of origin and entering other similar cells, an intriguing combination of infection and heredity. The parasitic conception, however, is a convenient working hypothesis. Nothing certainly disproves it, and it will probably

continue to hold the field until there is conclusive evidence of the origin of a virus *de novo*, as is already suggested by the work on bacteriophage and the filterable tumours

Animal pathologists lay great stress on filterability as an important character, and so no doubt it is when it occurs But its present importance is perhaps chiefly a historical residue Even in animal virus diseases it is not a constant character, and the plant pathologist attaches little importance to it, even in diagnosis, since most of the virus diseases of plants are not transmissible by extracted juice, whether filtered or not It is possible that it may come to have a real importance as a means of distinguishing viruses which can be detached from their cells without loss of character from those which cannot, but this is still in the future. One is glad to see that in the book under review the term 'filterable viruses' is used in a general non-committal way to cover all the active transmissible agents which produce virus disease

The present volume is sure of a welcome, and deserves it The amount of information that has accumulated on the subject of virus diseases since Iwanowski showed, thirty-seven years ago, that tobacco mosaic is filterable, is so enormous that even the specialist cannot keep abreast of it all. It covers so wide a field (mammals, birds, fish, plants, insects, even bacteria) and the literature is so widely scattered that it is difficult so much as to hear of all the papers that appear, and the collection of the salient facts into a single volume is a useful piece of work Even in this volume of more than 400 pages, detailed survey has proved impracticable, and the method adopted is to select certain diseases of man, animals, fowls, etc , and treat them as typical examples of the different groups, prefacing them with some chapters of a more general nature.

The first chapter, on "Some General Aspects of Filterable Viruses," by the general editor, T M Rivers, has already appeared in the *Journal of Bacteriology* It discusses in a series of short sections such questions as epidemiology, immunity, filterability, size and the like, giving briefly the ascertained facts and occasionally the theories. This chapter, we think, might have been considerably expanded The book, as a whole, no doubt aims mainly, and commendably, at recapitulating established fact rather than theoretical discussion; but—to take only one example—to abandon a consideration of whether viruses are animate or inanimate, on the ground that "it leads one into the sterile discussion of what life is, a problem still in the realm of metaphysics," seems scarcely adequate

An excellent chapter follows on filters and filtration, by Stuart Mudd, practical and sane, and also salutary because many unwarranted conclusions have been drawn from experiments with filters The third chapter is by A Carrel, on tissue-culture, in the study of viruses, a method likely to lead to greater results than it has produced as yet E. V Cowdry contributes a cautious, well-balanced, and informative discussion on intracellular pathology, with excellent illustrations, coloured and uncoloured.

Then follow the special articles already referred to Poliomyelitis in man by H L. Amoss, foot and mouth and vesicular stomatitis by P K Olitsky, contagious epithelioma in birds by E W Goodpasture, virus diseases of insects by R W Glaser, of plants by L O. Kunkel, and of bacteria by J J. Bronfenbrenner All these are authorities on the subjects of which they treat, and, although in every case a specialist will no doubt wonder at some omissions and feel disposed to quarrel with some statements made, still they do give excellent reviews of present knowledge and convenient summaries of present opinion, and that is what one hopes to find in chapters such as these They are addressed not so much to the specialist, who presumably knows the facts of his own subject, as to the semi-specialist and the worker on cognate lines, who cannot easily keep in touch with current knowledge outside his own limited field. This function they serve admirably. The whole volume is a most useful and convenient collection of the available information on filterable viruses

J Henderson Smith

Problems of Island Life

Diptera Brachycera and Athericera of the Fiji Islands based on Material in the British Museum (Natural History) By Mario Bezzi Pp. viii + 220 (London British Museum (Natural History), 1928) 15*s*

ISLAND life presents problems of great interest to the biologist and in particular to the student of geographical distribution Among the many islands of Polynesia a great field for research awaits inquiry In so far as the insects and other invertebrates are concerned, we know as yet comparatively little respecting what peculiar forms are present, how the creatures of one group of islands differ from those of another, and from where they have been derived.

The Hawaiian group is better known than any other Pacific archipelago, a fact largely due to the wisdom and foresight of those Englishmen who inaugurated the "Fauna Hawuensis" and saw it through to completion. Its volumes form the groundwork for all subsequent progress in Hawaiian entomology, besides providing an important contribution to the problems of island life in general The work was not instituted one month too soon —in fact, species had already disappeared and become lost to science before its inception To-day the spread of cultivation on the island of Oahu, for example, has practically destroyed the whole of the indigenous insect fauna over most of the terrain—what is left is mainly to be found on the forest-clad flanks of its steep mountains Without the "Fauna Hawiiensis" we should be at a loss to-day to know whether many of the insects are introduced or indigenous, and when it comes to problems of pest control this knowledge acquires added importance. The work of the Percy Sladen Trust Expedition, under Prof J Stanley Gardiner, has similarly laid the foundations of our knowledge of the fauna of the Seychelles and neighbouring islands in the Indian Ocean.

It is only a matter of time when Fiji, Samoa, and all the larger oceanic islands will inevitably come under the influence of cultivation to the same extent as the Hawaiian group To-day they are changing, and new elements are entering their fauna through the agency of increased maritime communications Sooner or later a highly composite and drastically altered fauna will result There is no doubt, therefore, if we are to have an adequate knowledge respecting the native insects and other elements of the fauna of Polynesia, every opportunity needs to be utilised, at least to collect material, before civilisation advances much further It might be feasible to circularise and impress this fact upon all resident naturalists and induce them to send specimens to our national collection It may be necessary to provide them with instructions, store boxes and apparatus, but it would be worth while and the costs would be relatively trifling

The small volume by the late Prof Bezzi, now before us, consists of a series of highly technical detailed descriptions of flies from the Fiji Islands Since its author was one of the most eminent of Dipterists, it is consequently authoritative Altogether 239 species of flies are dealt with, and it is noteworthy that only 30 of them were known to exist in Fiji (including the Tonga Islands) up to the end of the year 1925. It is also interesting to note that 60 per cent of the flies enumerated are endemic to Fiji, and nearly all were previously undescribed Certain families of flies, notably the Ortalidæ, Trypetidæ, Chloropidæ, and Muscidæ, comprise, on the other hand, a good many non-endemic forms, probably on account of their association with the activities of man Their distribution by commerce in fruits and other vegetable matter, or by the drifting of trees and plant debris in the sea, accounts for the presence of a considerable number Excluding the imported elements, the Fijian dipterous fauna is an endemic one of Austro-Malayan origin. A point of great economic importance is the fact that the Mediterranean fruit-fly (*Ceratitis capitata*) is happily absent from the list, and yet it is a pest in some other Pacific islands

The Natural History Museum has done zoology a service in publishing this volume, and it is to be hoped that its appearance will stimulate the collection of further material bearing upon the unique problems of island life A D IMMS

Methods of Sea-water Biology.

Handbuch der biologischen Arbeitsmethoden Herausgegeben von Prof Dr Emil Abderhalden. Lieferung 256. Abt 9 *Methoden der Erforschung der Leistungen des tierischen Organismus*, Teil 5, Heft 2 *Methoden der Meerwasserbiologie* Über Kultur und Methodik beim Studium der Meerespflanzen, von Josef Schiller, Methoden der Untersuchung der Bodenfauna des Meerwassers, von Harald Blegvad Pp 181-330 +11 Tafeln (Berlin und Wien Urban und Schwarzenberg, 1928) 10 gold marks

SCHILLER'S work occupies 129 pages of this part of Abderhalden's "Handbuch," the remaining 20 with 11 tables being Blegvad's portion The former contains detailed information on the setting up of small aquaria, their aeration and temperature control Some account is given of the chemical composition of sea-water and of the various salt solutions used for the culture of fresh-water and marine algae; sections are devoted to the organic nutrients useful in the study of marine Chryso- and Cryptomonads and other plants, also to solid media and colloidal solutions Attention is directed to the necessity of regulating the intensity of the light, and details are given concerning the construction of various types of light filter, solid and liquid. References are made in particular to Pringsheim's work on the culture of algæ, mention is made of Schott und Gen's light filters,

but the Wratten and Corning filters have been omitted

Throughout, one is struck with the fewness of the references to British and American work—but then British marine biology has been preponderatingly zoological, and Oltmanns remains the standard authority on the marine flora of a seagoing nation The Americans, though active on the Pacific coast, have been late comers into this field. A section is devoted to the isolation of organisms required for pure cultures and there is a figure of a pipette, with rubber teat, of quite unserviceable thinness, the centrifuge tube shown would break at the first time of using Simple forms of water-sample bottles are shown, but the standard Nansen-Petersen is not mentioned

The purely botanical portion is done with Teutonic thoroughness, the groups being considered one by one in great detail. The reviewer confesses to a feeling of surprise at reading of the large number of algæ that have been cultivated Mention is made of Thuret's early (1854) work on the crossing of *Fucus vesiculosus* and *F serratus* also of subsequent work by Lloyd Williams and by Sauvageau. Overton's (1913) work on the parthenogenesis of the ova of *Fucus*, induced artificially, has been included When it was first published, the reviewer repeated it—the experiment goes beautifully. Nobody appears to have used algal material for such studies since Overton published, which is strange, since sea urchin and other animal eggs have been worked at assiduously In conclusion, the Phanerogams *Zostera* and *Posidonia* are mentioned in virtue of their marine habitat, and a long list is given of the algæ of the Adriatic, North and Baltic Seas, with their vegetation periods and ease of cultivation

The whole article constitutes a very useful compendium of the present state of knowledge on this subject

Blegvad's article deals mainly with various bottom-grabs, such as that of the late Director C G. Joh. Petersen For quantitative work, grabs are made to cover 0 1 m ^{2} or, for larger animals, 1 m.^{2} These are described and illustrated It is hard to see the value of including pictures of a dredge swung clear for use, of a boat with square net, and of partly filled sample bottles. The results obtained with the bottom-grabs are of great interest A figure gives the large annual variations, from 1910 until 1922, in the population density of the sea-bottom at one station in *Abra alba* and in *Solen pellucidus* The bottom fauna in Timfjord is worked out in great detail in Table 1. Other tables (plates) show pictorially the distribution of animals in the various associations (*Besiedlung*, colonisation) or communities found on different types of sea-bottom. These are excellent, as it is very difficult to visualise the meaning of numerical fauna lists Plate XI shows the seas surrounding Denmark stippled and marked to show the areas covered by the various communities No other seas have been worked out with such detailed accuracy This article is commendably brief, and is packed with information

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Our Bookshelf.

Chemical Publications · their Nature and Use By Prof M G Mellon (International Chemical Series) Pp viii + 253 (New York · McGraw-Hill Book Co, Inc ; London McGraw-Hill Publishing Co, Ltd, 1928) 12*s* 6*d* net

To the several books and various other publications that deal specifically with the topography of the literature of chemistry is now added one which, in addition to supplying the usual kind of information and advice in the manipulation of such tools as are available—extremely valuable as both are—goes a step further, and drives its lessons home by providing material for practice in the specialised technique which is described. Already, of course, chemical literature has reached such vast proportions (having grown at a rate not altogether indicative of real chemical progress) that we feel a lurking sympathy for the business man who had to give up business in order to attend to his card index Moreover, the areas of intersection of chemical and other scientific spheres have tended to enlarge and become indistinctly defined

It is not surprising, therefore, that general excursions having in view an exhaustive examination, a rapid disinterment of what in the circumstances may be buried treasure, or even a hurried survey to provide a background for some commercial decision, tend more and more to be entrusted to specialists, or at any rate practicians, in the art For exactly the same reasons it is clearly desirable that students of chemistry should find time to familiarise themselves with the records of their subject The material in this book is intended to constitute the basis of an undergraduate course

There are nine chapters, in which the development of the literature, original sources (periodicals, institutional proceedings, patents, and miscellaneous contributions), and secondary sources (periodicals and serials, bibliographies, works of reference, and text-books) are discussed, and the technique of the search is described The subject is placed on a class-room basis—or rather, on a library basis—by the inclusion of fourteen groups of problems (arranged in a manner somewhat reminiscent of 'prep. in the lower fourth'), in which the student is required, for example, to supply full details concerning an assigned journal, to collect, complete with 'chapter and verse,'

selected physico-chemical data, or to 'look up' an organic compound. Most chemists have learned the use of the literature in the school of necessity, so that although its appearance as an exercise may seem to them somewhat strange and curious, they will all the more readily perceive the advantage of early systematic direction A. A. E.

Radiomovies, Radiovision, Television. By C. Francis Jenkins. Pp. 143. (Washington, D.C.: Jenkins Laboratories, 1929.) 2.50 dollars.

C. F. Jenkins, the author of this work and one of the pioneers of television, took up inventing as a profession about thirty years ago. He now possesses more than four hundred patents in America and other countries, and has a private laboratory in Washington for carrying out his researches. He has done an immense amount of work in developing 'radiomovies,' both by using wires (television) and by transmitting them by radio waves (radiovision).

In July last, Mr. Jenkins began broadcasting radiomovies at fixed times. He thus gave the amateurs something for which to 'angle.' A few weeks later more than a hundred amateurs had finished their receivers and could reckon with certainty on getting their regular picture stories. At first only silhouettes were broadcast, as it was essential to keep the frequency band less than ten kilocycles. The Radio Commission has now assigned to his company a band 100 kilocycles wide (4900-5000 kilocycles), and at the present time thousands of amateurs receive half-tone 'movies' on their receiving picture sets. The pictures transmitted are mainly pantomime pictures, but Mr. Jenkins expects that his new machine, which is practically finished, will revolutionise the art and make it possible to transmit pictures of theatrical performances, outdoor games, inaugural ceremonies, and even grand opera with full vocal accompaniment.

This book describes how to make and work a receiving set. It concludes with descriptions of other of Mr. Jenkins's inventions, including a landing altimeter which enables an airman to glide his machine to a landing in a fog, a novel method of predicting hurricanes by means of the snapping noises they produce in a radio receiver, and a method of guiding an aeroplane on its course in a fog. He is the inventor of the motion picture projector, the principle of which is in use all over the world. The Franklin Institute awarded him a gold medal for this invention in 1895.

The Journal of the Institute of Metals. Vol. 40. Edited by G. Shaw Scott. Pp. xii + 877 + 37 plates. (London: The Institute of Metals, 1928.) 31*s*. 6*d*. net.

Reports on the corrosion of condenser tubes and on the properties of alloys for die-casting occupy a prominent position in the new volume. The work on corrosion has had a definite result in showing that cupro-nickel and a special aluminium brass have a high resistance to attack by streams of air bubbles carried off by the water, perhaps the most frequent cause of damage. The researches of this committee have proved particularly valuable to the tube industry.

Die-casting has made great progress in recent years, although even now it is far less used in Great Britain than in America, and the present papers contain valuable information as to the metals best suited to this class of work. W. Hume-Rothery describes the methods most suitable for the preparation and study of alloys containing highly reactive metals, such as sodium and calcium, and F. Hargreaves continues his investigations of alloys which are softened by cold working instead of being hardened. An example of the detailed study of a complex alloy system is that of the alloys of aluminium with copper, silicon, and iron by A. G. C. Gwyer, H. W. L. Philips, and L. Mann, illustrated by very good photomicrographs and by numerous diagrams. Under ordinary conditions of cooling, these alloys depart considerably from equilibrium, so that they are used in a metastable condition. An unexpected result is recorded by D. R. Tullis, who has freed aluminium alloys from the gases causing unsoundness by passing a stream of chlorine through the molten metal, this process, unpromising at first sight, having proved to be technically successful.

The volume contains many other papers and the usual abstracts.

Travels and Settlements of Early Man: a Study of the Origins of Human Progress. By T. S. Foster. Pp. 320. (London: Ernest Benn, Ltd., 1929.) 21*s*. net.

Mr. Foster has worked over the data of palæontology and prehistoric archæology in their bearing upon the distribution of man with considerable ingenuity, and still greater enthusiasm, which have involved him in frequent departures from the orthodox view. He is both stimulating and provocative. He is an ardent supporter of what he calls the Anatolian strain, that is, a race originating in the Anatolian plateau of what is more usually called the Armenoid type, as a factor in the development of civilisation. He has allowed full play to his theory when working out racial strains in the culture of the Pacific. Although it cannot be said that this is entirely assumption, the evidence is a very slender support for so elaborate a superstructure. His view of the origin and growth of American culture depends upon the acceptance of the Calaveras and New Jersey skulls—which are more than doubtful—and the Central and South American early civilisations seem to be left hanging in the air.

New Worlds for Old: the Realm of Modern Physics. By Robert G. Lunnon. Pp. v + 106. (London: Methuen and Co., Ltd., 1928.) 2*s*. 6*d*. net.

This little book is intended for those of the general public who are not acquainted with the modern developments of physics. It is a perfectly accurate, though necessarily incomplete, account of the discoveries of the last twenty-five years. The writing is most suitable for a book of its kind, and the average reader is not likely to arrive at false conclusions, as is so often the case, through the fact that the terminology is beyond him.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Nature of the Penetrating Radiation.

Up to the present time the view that the penetrating radiation consists of short gamma rays has been prevalent chiefly because the large penetrating power which these rays possess is associated with radiation of gamma ray type. Our recent experiments, however, indicate that this radiation is of corpuscular nature.

The experimental arrangement consisted simply of two 'tube-counters,' of the type recently developed by Geiger and Muller (*Die Naturwiss.*, **16**, 617, 1928), which were placed above one another at some distance apart in a space screened by 6 cm. of lead and 5 cm. of iron. Each of the counters was connected to an electrometer, and the deflections of the two electrometers, which were due chiefly to the penetrating radiation (Geiger, *Phys. Zeitschr.*, **29**, 839; 1928), were registered side by side on a moving film. With this arrangement a considerable number of simultaneous deflections of both instruments was recorded. For small distances between the counters, up to about 20 per cent of the total number of deflections of one counter were coincident pairs. This percentage is so great that it must be explained on the basis that coincidences occur if the same corpuscular ray enters both counters.

Two hypotheses may be made concerning the origin of this corpuscular radiation. One is that the primary radiation may be of the gamma type and the coincidences the result of secondary electrons. In this case one would expect the corpuscular rays to be more easily absorbed than the penetrating radiation that caused them. The alternative is that the penetrating radiation is really of corpuscular nature, in which case agreement should exist between the absorption coefficient of the rays causing the coincident deflections and that directly measured for the penetrating radiation itself.

In order to distinguish between these alternatives, a block of gold 4·1 cm. thick was placed between the counters, the diminution in the number of coincidences thereby giving a measure of the absorption of the corpuscular rays. The first attempts were made in a laboratory of the Reichsanstalt, where the thick floors and ceilings of the rooms above us greatly hardened the radiation. There was no definite diminution in the number of coincident pairs under these conditions. We then repeated the experiment on the roof of the building with the lid of the screen removed. Under these conditions the unfiltered radiation from above acted directly on the counters, and a definite diminution in the number of coincidences was observed on introducing the gold block. The observed difference gives (μ/ρ) Au $=(3{\cdot}6 \pm 0{\cdot}5) \times 10^{-3}$ for the mass absorption coefficient. This value agrees well with that measured directly for the unfiltered cosmic rays. We conclude from these data that the penetrating radiation is not of gamma but of corpuscular type.

The complete description and discussion of these experiments will appear in the *Zeitschrift fur Physik*.

W. Bothe.
W. Kolhörster.
Physikalisch-Technische Reichsanstalt,
Berlin-Charlottenburg,
Meteorologisch-magnetisches Observatorium,
Potsdam, April 3.

Temperature Conditions in the Suez Canal, July–December 1928

The study of the temperatures met with in the Suez Canal is invested with more than ordinary interest in view of the linkage affected between two different sea areas and the possibilities of an exchange of faunas.

The Cambridge expedition to the Suez Canal (*Transactions of the Zoological Society*, 1927) has shown that more marine animals have moved from the Red Sea to the Mediterranean than from the Mediterranean to the Red Sea. The expedition also published valuable evidence to show that for most of the year the canal water was under the influence of a slow residual drift from the Red Sea. This, however, was reversed during the months of the Nile flood.

In studying the question of the migration of young or drifting organisms through the canal, temperature has very rightly been considered as of first importance as a possible limiting factor.

The only series of data concerning the temperatures of the canal that offer anything like a contemporaneous series are those taken by the *Pola* expedition in October 1895 and May 1896.

The present observations were all made within two days on each occasion and so were very nearly simultaneous.

The following list shows the positions at which they were made:

Suez Canal Station 1. Opposite entrance buoy to Suez Canal, Port Said.
,, ,, 2. Opposite Canal Company's signal station at Ballah.
,, ,, 3. 1 kilometre S.E. of the Canal Company's landing stage at Ismailia.
,, ,, 4. Opposite the Northern Light Buoy of the Great Bitter Lakes.
,, ,, 5. "Kilometre 130" of the Canal.
,, ,, 6. Opposite the last buoy but one of the Suez Canal at Suez.

It is the intention of the directorate of Fisheries Research, Coastguards and Fisheries Service, to take routine temperature and salinity observations from these positions over a run of years.

The surface observations for July 1928 and February–March 1929 are shown here:

Station	S C 1	2	3	4	5	6
Date	19 7.28	19 7 28	19 7 28	20 7 28	20 7 28	20 7.28
Time	1043	1450	1637	1228	1628	1855
Temperature, °C	28 92	29 28	29 60	29 18	28 85	26 55
Date	28 2 29	28 2 29	28 2 29	1 3.29	1 3 29	1 3 29
Time	1034	1505	1705	1139	1343	1753
Temperature, °C	14 32	14 70	14·96	15 25	17 85	17 53

A Nansen-Petersen insulated closing bottle was used with a Schmidt thermometer.

Examining the Cambridge and *Pola* expedition temperatures, one is struck by the anomaly of higher figures for Port Said than for Suez. This same condition is shown in my figures for July. In February–March, however, there is a higher temperature at Suez than at Port Said, and from Station S.C.2 to Suez there is a steady rise along the whole length of the canal.

There seems to be, then, a higher temperature at the northern end of the canal than the southern in summer, and a higher temperature at the southern than the northern end in winter. This relatively higher summer temperature of the water at Port Said is quite inexplicable on ordinary considerations of position, and I am led to suggest the following explanation.

The sea in the neighbourhood of Port Said is constantly receiving Nile water. This comes out through a large shallow lake—Lake Menzaleh—and in the summer and autumn through the Damietta mouth of the Nile. Travelling through a thousand miles of heated desert—partly discharging through a shallow lake which is rapidly heated by the sun—the effluent water of the Egyptian Nile is much hotter than that of the Mediterranean Sea in the summer.

The order of the temperatures in these delta lakes is well shown by Paget (Fisheries Report of Egypt, 1921). It will be seen that the average monthly temperature in August and July is 30° C

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Mar. 26.

Anti-Knock Ratings of Pure Hydrocarbons.

PROF. NASH and Mr. Howes emphasise the fact that whereas their figures for trimethylethylene and diamylene were quoted for twenty per cent volume concentration, our own were for twenty per cent weight concentration From curves obtained for these hydrocarbons, reproduced in Fig 1, it is clear

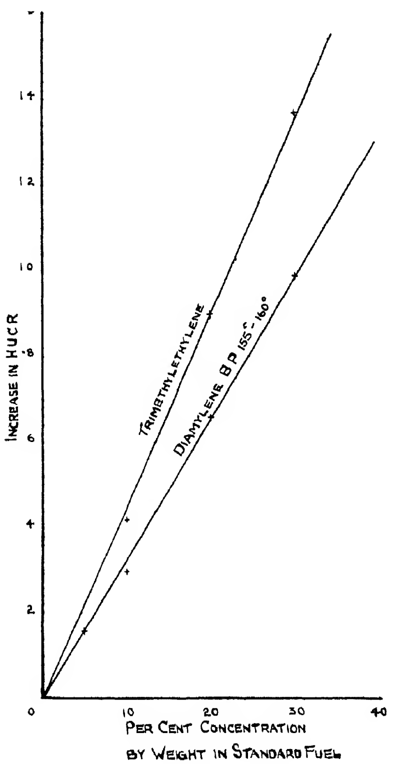

FIG 1

that over the range examined the relationship between weight-concentration and increase in H.U.C.R. is linear Knowing the specific gravities, it is a matter of simple calculation to show that the discrepancy cannot be due to our use of what we regard as the only rational procedure. The specific gravity of the standard fuel was 0·725 at 60° F.

So far as the possible effects of volatility are concerned, all tests at these laboratories are carried out with sufficient intake air, heating, and jacket and head temperature to ensure that no appreciable difference in anti-knock rating is found with any further heating, whether low boiling gasolines or heavy kerosines are being tested

The recent recommendations made by Campbell, Lovell, and Boyd regarding the importance of making all comparisons at the mixture strength which gives maximum pinking have been in use here for upwards of two years. The Armstrong engine developed independently in these laboratories while their work was in progress includes both variable compression head and bouncing pin

In order to find definitely whether differences in volatility are the cause of discrepancies between one fuel and another, experiments have been carried out with

1. Standard heating conditions and compression adjusted to suit the sample.
2. Evaporative cooling, high compression and throttling to control the pinking as is the practice when using the Delco engine.

The mean results were identical, although the values of single readings using the second set of conditions were more erratic owing probably to the method of cooling which tends to induce stray hot spots

We feel that possibly complete agreement might be reached on those points still in doubt if tests were carried out using a common supply of trimethylethylene and diamylene in both engines, employing a range of air-fuel ratios.

In the case of the Ricardo E.5 engine and the Armstrong engine used in this laboratory, the effect of air-fuel ratio has already been thoroughly studied. Similar experiments could be made without alteration to apparatus on the Delco plant, and we have no doubt concerning the ultimate results.

Confirmation of the accuracy of our figures is afforded by the fact that substantially identical values are obtained using such a wide range of research engines as

(a) The Thornycroft overhead valve engine of 1025 c.c capacity. (b) The Ricardo sleeve valve engine of 350 c.c. capacity (c) The Armstrong engine with a fixed ratio head. (d) The Armstrong engine with a variable compression head.

S. F. BIRCH.
R. STANSFIELD.

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Meadhurst Laboratories,
Sunbury-on-Thames.

WE would thank the Editor of NATURE for kindly allowing us to reply to the above letter of Messrs Birch and Stansfield, but feel that we must not trespass on the space of this journal any further in that all contribution to our knowledge of the subject under discussion ceased with our letter which appeared in the issue of April 6.

In our previous communication no suggestion was made that the difference in the results obtained for diamylene and trimethylethylene was due entirely to the fact that Messrs. Birch and Stansfield employed concentrations by weight, whereas we used concentrations by volume. Nevertheless, the fact must necessarily contribute to the discrepancy.

It is also not impossible that the samples of diamylene as used by Messrs. Birch and Stansfield and ourselves were not chemically identical. The boiling ranges were not the same, and seeing that the diamylene as made from trimethylethylene is

probably not a single chemical entity but a mixture of isomers, the composition of the diamylene produced may vary with the method and condition of the particular polymerising reaction used. Diamylene, prepared in this way, cannot be chemically described with the same certainty that would be associated with trimethylethylene.

With regard to the other point raised, it is well known that differences in results obtained by different workers with different engines may be due to technique and design, and it is well realised that concordant results will never be obtained until a standard method of test is employed by all laboratories

We welcome Messrs. Birch and Stansfield's suggestion of carrying out tests using a common supply of trimethylethylene and diamylene in both types of engine, as we feel that such collaboration would result in a much greater advance than further correspondence at this stage of our knowledge

In the meantime, it is known to us that research workers in the United States have been carrying out similar investigations for some years, and now that the results of our work have been disclosed, it would add materially to our knowledge of the subject if they would publish their conclusions.

A. W NASH
DONALD A HOWES
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University of Birmingham

Rise and Fall of the Tides.

FROM information published by the Hydrographic Department of the Admiralty it is possible to find the rise and fall of the tides and the times of high and low water on almost all the coasts of the world except in the extreme north and south latitudes

The periods of the tides depend on astronomical conditions, and the many terms which are involved have been investigated. The periods, however, furnish no information as to the tidal range, that is, the difference in elevation between high and low water.

A very simple calculation, however, depending merely on the masses and distances of the tide-producing bodies, suffices to show that were the earth fluid and devoid of rigidity, then the difference between the semi-axes of the tidal spheroid would be of the order of one in twenty million, or about a foot at the earth's surface.

From the Admiralty Tables it will be seen that on coasts facing the open ocean the observed rise and fall in relation to the land lies somewhere between 5 and 10 feet on the average, but that where the coast-line is complicated and the water shoals gradually, far greater variations appear, which may range from 0 to 50 feet.

It is not necessary to go outside the English and neighbouring coasts to find examples of such differences. For example, near the mouth of the English Channel the rise and fall is about 20 ft., in the Bristol Channel, nearly 50 ft.; at Portland, about 5 ft., and in the neighbourhood of Mt St Michel, 50 ft. These large differences may be accounted for in part by interference, that is, by the tide reaching the position of observation by different routes of unequal effective lengths; or again, resonance may be involved, as is apparently the case in the English Channel, where high and low water at the opposite ends occur at the same time

The most general cause, however, which operates to make the coastal rise and fall so much larger than the equilibrium tide in the open ocean, is the gradual concentration of energy which occurs when a wave of small amplitude but large mass travels from deep to shallow water.

Among many familiar examples which depend on the same sort of concentration of a constant amount of energy in a gradually diminishing mass, may be mentioned the cracking of whips, flapping of flags and sails, throwing a rope, and throwing a fly, and I will add three more where the results can be readily calculated

(1) A heavy flexible cord passes through a hole in a fixed horizontal plate. That part of the cord which hangs free below the plate is given a small horizontal velocity and swings as a pendulum. The cord is then drawn upwards through the plate Above the plate the cord is stationary, and the energy it contained is transferred to the part still hanging free, the mass of which continually decreases with the length of the free part Hence the horizontal velocity of that part tends to become infinite when the length vanishes

(2) A light reel is wound with a few turns of massive but flexible cord and placed on a horizontal table to which one end of the cord is attached. Two forces act on the reel, both tending to make it roll away from the point of attachment of the cord to the table, namely: (*a*) the weight of one half turn of the cord acting at half the radius of the reel, and (*b*) the horizontal component due to the centrifugal force of the mass of half a turn of the cord at the velocity of the rotation of the reel. As the rolling proceeds the cord is left at rest on the table, and the energy is gradually concentrated in the remaining turns. Hence the angular velocity tends to become infinite as the last part of the cord leaves the reel

(3) An endless massive but flexible belt connects two wheels lying in the same plane The wheels are given a certain spin, and both parts of the belt are then cut at the same instant half-way between the wheels. What is the subsequent motion of the two parts of the belt? Before cutting, the total momentum is zero If the line joining the centres of the wheels is taken as the axis of X, the momentum parallel to X remains zero for both parts, but after the cut is made is equal and opposite in direction for the two parts its amount being the component parallel to Y of those parts of the belt which are in contact with the circumference of the wheels. The centres of inertia of each part remain at a constant distance from Y, but move at a constant speed parallel to Y, one to the right and the other to the left of X according to the direction of the spin It will be found that the cut parts of the belt assume in succession the shape of alternate right-handed and left-handed pot-hooks, becoming straight lines for a single instant with an infinite terminal velocity parallel to Y

How very large the velocities attained by the concentration of energy may become in real cases is shown by the crack of a whip, where the few feet per second originally given to the lash rises to explosive velocity at the last instant

The gradual increase in the height of gentle waves as they approach a shelving beach is familiar to most people, and the same sort of action must accompany the small disturbance which constitutes the tidal wave in deep water as the latter shoals

What the equilibrium rise and fall relative to the floor of the deep sea really is, is quite unknown either by observation or by theory.

In the *Phil. Mag.* (vol. 50, pp. 228, 278) there are papers by Sir G. B. Airy and Sir William Thomson which touch on this subject and on Laplace's theory of the tides. Airy objects to some of Laplace's work which is upheld by Sir William Thomson.

Laplace's spherical harmonics are so general as (if the restriction is not specially introduced) to cover the introduction or withdrawal of fluid at the poles —the condition of constancy of fluid volume was in

effect introduced by Laplace, and this Airy calls a "singular and unwarranted principle" Sir William Thomson says this unwarranted principle is in fact an "exquisitely subtle" method by which Laplace determined a certain constant, and Airy rejoins, "I look on Laplace's process as a mere sport with symbols and on Laplace's conclusion as a grievous error." Whether, however, Laplace is right or wrong, his conclusion applies to an ocean covering the whole surface of the earth, and would not help to determine the motion of the fluid as actually distributed in the existing seas.

The question of the earth's rigidity also would have to be settled before any theory could give a quantitative estimate of the true amplitude of the equilibrium tide.

Sir William Thomson (Thomson and Tait's "Natural Philosophy") states that unless the rigidity of the earth was at least as great as that of iron or glass, the tidal rise and fall would not be so great as it actually is In view, however, of the want of deep sea observations and of the amplification which occurs near a coast-line, the necessity for such rigidity does not seem to be proved.

I think the only satisfactory way to ascertain the amplitude of the tides in the deep ocean is by direct measurement, and though this presents some practical difficulties, it ought not to be impossible

A. MALLOCK.

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Evolution through Adaptation.

DR BATHER's lecture on "Evolution through Adaptation," printed in NATURE of Mar 30, bristles with debateable points, but I will select a cardinal one which appears to present a fundamental difficulty in his theory. He speaks of the changes of depth and salinity in the waters which have taken place in geological time and draws the conclusion "that the surroundings of a race are continuously altering, the race has perpetually to catch up with the change." But even if the small changes that have taken place in the oceanic environment could account for the trend of evolution, for example, from an Asteroid to an Echinoid form in the Echinodermata, how could be explained the persistence of the original Asteroid type practically unchanged? The race has not changed, if certain members or groups of it have.

Dr. Bather points out that "there is some tendency for change of form and structure to proceed in a definite direction," but he goes much further in stating that "the direction will accord with the environment" Apart from lethal factors in inheritance and non-viable monsters, what evidence is there that new forms in animal evolution are necessarily more in harmony with their environment than were and are the forms from which they arose? For example, many Echinoid and Asteroid forms share the same environment in the sea, but the Echinoid type is believed to have evolved from primitive Asteroidea How does the Echinoid trend of evolution accord better than does the Asteroid with the environment which they both share? Migration as a factor in isolation of species can be ruled out, of course, if the original and the 'evolving' line have always shared the same environment.

The mutations required by Dr Bather's theories can of course be admitted, as they can be seen and investigated, but they only "provide that fundamental premise from which, *in combination with a varying environment* [italics mine], one can deduce irreversibility of evolution . . . and orthogenetic trends" This would be true only if it could be shown that the varying environment favoured the new forms at the expense of the old, but actually the older forms are often as well adapted to the varying environment as are the new ones Another objection is that, while the slight changes that have taken place in the physical and chemical constitution of the ocean would affect such processes as fertilisation and early development in various ways, it is difficult to imagine how such changes can have directed the general "orthogenetic trends" in adult oceanic forms. Furthermore, the persistence of primitive or early forms in the same environment is evidence against such a view.

J. S. DUNKERLY.

IN speaking of "Dr Bather's" theory and theories, Prof Dunkerly pays me too much honour. That portion of my discourse which appeared in NATURE attempted a critical inquiry into other people's theories and a possible explanation of certain difficulties that they presented to my mind. To Prof. Dunkerly's mind the main theory presents yet another difficulty. He admits, apparently, the fact of evolution, and he admits some change of environment, but he urges (I understand), first, that the changes of environment are too slight to produce the great evolutionary changes seen along certain lines; secondly, that if they were a *vera causa* they would have affected all lines of descent in a more equal degree

It is rather late in the day to be answering arguments of this kind, and space could not be afforded in NATURE for their adequate discussion. May I suggest, first, that Prof. Dunkerly underestimates the differences and the changes in the environment of sea animals? If he derives his conception from a single summarising sentence in my discourse, I would remind him that two-thirds of that discourse (not reported in NATURE) was devoted to an illustrated account of some among the numerous and varied habitats, conditions, and modes of life that a single class of marine invertebrates (and a statozoic class at that) has come to fill during its long history. It was emphasised that a single small patch of sea-floor, which we speak of roughly as sand or sea-weed or reef and so forth, really comprises many habitats. On the other hand, it was urged that, just as one cannot envisage a living creature apart from its environment, so one should not conceive of the environment without the reaction of the creature; further, that the whole creature constitutes the environment of any one of its parts.

Consider 'migrations,' on which Prof. Dunkerly seems to misapprehend me. Surveys of the sea-floor, notably by the Danes, have shown that the immigration or emigration of a single species from or to a faunal assemblage on a small patch must, and does, affect the life of all the other species, although purely physical conditions are unaltered. Or take mutation (which Prof. Dunkerly admits) and consider the Cladocera mutant found by Banta and Wood (see NATURE, Oct. 29, 1927, p. 632), here is a form that can live only at a temperature higher than the normal, and if it does find a warmer pool it will be preserved as a race adapted to a new environment. This does not mean that the original race will perish. Why starfishes should disappear because sea-urchins have (according to Prof Dunkerly) been evolved from them, I quite fail to understand. They fill different places in the economy of Nature, and to say that any of them "share the same environment" is scarcely so true as would be a like statement about a groom and his horse. I wonder what my friend Dr. W K.

Spencer will say to the assertion that the original Asteroid type has persisted unchanged

Prof. Dunkerly tells us that changes in the ocean water would affect fertilisation and early development. I said nothing about this; but what difficulty is there in supposing that embryonic change affects the adult history? We all know that it does, and the results might manifest just as much regular seriation as appears in any alleged orthogenetic trend However, I do not remember touching on this in that part of the discourse which Prof Dunkerly has been so good as to discuss.

F. A. Bather

The Fine Structure of the Normal Scattered Molybdenum $K\alpha$-Radiation from Graphite.

In the September issue, 1928, of the *Physical Review*, B. Davis and D. P. Mitchell reported an experimental investigation of the molybdenum $K\alpha$-radiation scattered by graphite with the aid of an ionisation spectrometer. In their work it is stated that the normal scattered radiation should have a much more complicated structure than the primary radiation. Instead of the one $K\alpha_1$-line they find four lines: one in the same position as the $K\alpha_1$ line and three lines shifted to the long wave-length side by 1·2, 2; 11·3 X-units respectively, the distance between the $K\alpha_1$ and $K\alpha_2$ being 4·28 X-units. As these shifts correspond more or less accurately to the L_{III}-, L_I-, and K-level of the carbon atom, the effect reminds one of the well-known Raman effect in the optical region.

Because of the high theoretical importance of these experiments, we have tried to repeat them, using the photographic method, but we failed to detect any difference at all between the structure of the primary radiation and that of the 'undisplaced' scattered line. In the meantime, Ehrenberg (*Zs. f. Phys*, 53, 234, 1929) published an analogous negative result. Still, we think it worth while to give a short discussion of our work in view of the importance of the problem in question.

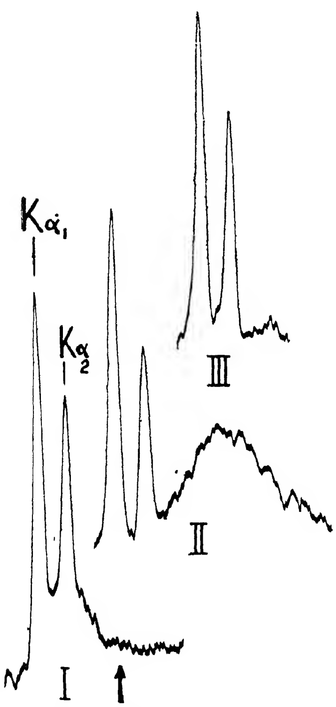

Fig 1 —Curve I Normal scattered radiation and Compton scattering Scattering angle from 25° to 50°. The Compton shift ranges from about 2 to 9 X-units
Curve II Normal scattered radiation and Compton scattering Scattering angle from 45° to 130° The Compton shift ranges from about 7 to 40 X-units
Curve III Direct radiation from molybdenum anticathode

The spectrograph used was of the Siegbahn type, calcite was used as analysing crystal, the dispersion was such that the distance between the $K\alpha$-lines was 0·19 mm. on the photographic plate The scattering graphite was put on the cathode inside the X-ray tube, the alternating tension was 35 kv. eff., the current 25 ma. By taking control photographs it was ascertained that only the radiation scattered by the graphite could reach the photographic plate. All the photographs taken were registered with a photometer of the Moll type (see Fig 1) Plate I was taken with the graphite at a distance from 5 to 15 mm from the anticathode focus. The time of exposure was 35 hours. At the small scattering angles from 25° to 50°, the Compton scattering is confused with the normal scattered lines At a distance, however, of 11·3 X-units from the normal $K\alpha_1$-line where Davis and Mitchell found their weakest component of the scattered complex line (see arrow to curve I), we see that there cannot be any line with an intensity of more than 2 per cent of that of the scattered $K\alpha_1$-line. Plate II was taken with the graphite at a distance from 15 to 20 mm. from the focus. The time of exposure was 75 hours On this plate the region between the $K\alpha_1$ and $K\alpha_2$ is wholly free from Compton radiation. In this region Davis and Mitchell found two other components of the complex line. From a comparison, however, of curve II with curve III, which relates to the spectrum of the direct radiation, we conclude that there seems to be no essential difference at all between the normal scattered $K\alpha$-doublet and the direct radiation.

It might be remembered that if there should exist in the X-ray spectrum something analogous to the Raman effect in the optical region, we should expect this to give rise not to lines but to a *continuous* spectrum, which we should not be able to detect with the means used in our experiments

D Coster.
I Nitta.
W. J. Thijssen.

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Variation of Conductivity of the Upper Atmosphere.

Measurements of the height of the base of the aurora in northern Norway by C Stormer (*Geofys. Publ*, I., No. 5) and by L. Vegard and O. Krogness (*Geofys. Publ.*, I., No 1) show that a considerable number of the bases are situated at heights of about 100 km. and about 106 km (compare the frequency curve, Fig. 18, *Geofys. Publ*, I., No. 1, p. 101) In treating 1737 base-heights between 90 and 120 km it was found from the frequency curve that during ebb-tide in the atmosphere the maximum at 100 km. was predominant, while during flood-tide the maximum at 106 km was predominant. Further investigations have shown that the maxima of the frequency curve are to be considered as displacements of one and the same maximum. From this we conclude that, as regards the locality considered, the mass of air situated above 100 km. at ebb-tide is the same

as the mass of air situated above 106 km. at flood-tide.

When adopting all the assumptions and results given in "The Propagation of Radio Waves" by P. O Pedersen (Copenhagen, 1927), it is possible to show how the conductivity of the upper atmosphere (130-160 km) is influenced by the different states during ebb-tide and flood-tide. Let us assume that the mass of air above a certain height varies with height in accordance with an exponential function, and let us consider, within the conducting layer, a thin layer under normal conditions and with a certain conductivity. Then the problem consists in finding the variation of the conductivity caused by the atmospheric tide On account of the slower decrease in the vertical direction of the mass of air above a certain height, a thin layer with the same electric properties as the above-mentioned thin layer will grow thicker at flood-tide, while at ebb-tide a corresponding thin layer will grow thinner The total conductivity will therefore vary according to the atmospheric tide. For the place of observation (70° northern latitude), the total conductivity is found to be 4 3 per cent greater at flood-tide than at ebb-tide.

Considering the lunar diurnal magnetic variation as a variation caused in the solar diurnal variation by tidal forces, and supposing proportionality between the conductivity in the upper atmosphere and the magnitude of magnetic variations (S. Chapman), it is found from the variations of the magnetic declination that near the equator (Batavia) the conductivity at flood-tide is 21 per cent higher than at ebb-tide. For latitude 70° an increase of 2 5 per cent in the conductivity from ebb-tide to flood-tide is to be expected. The discrepancy with the above result is removed when, instead of a supposed temperature of the stratosphere of − 54° C., a temperature of − 78° C. is used, after Dobson (*Proc Roy Soc.*, A, vol. 103, pp. 339-342) such a temperature of the stratosphere may be possible during the nights in which the measurements of the base-heights of the aurora have taken place. A consequence of the above is that the height of the conducting layer will vary during the lunar day. In latitude 45° a variation of 25 per cent from the mean height may be expected, a point on which the investigation by radio waves may be able to throw some light.

Summarising, it may be said that the heights of the base of the aurora are able to give information on the tide of the upper atmosphere and thereby on the variation of the electric conductivity in the regions considered; further, that certain observed magnetic variations seem to confirm the result found The existence of a resulting enormous variation of the height of the conducting layer may be tested by means of radio waves.

J. EGEDAL.

Meteorologisk Institut,
Kjøbenhavn,
Mar. 25.

A Violation of the Selection Principle for the Principal Quantum Number.

ONE of the selection principles, for the case of X-ray spectra, states that the principal quantum number must change in any electron transition. A thorough investigation was carried out by Coster (*Phil. Mag.*, **43**, p. 1070; 1922) to determine if lines could be found corresponding to electron transitions between L levels, but no such lines were observed. No violations of the principal quantum number selection rule have yet been found By using the grating method, Thibaud and Soltan (*Journal de Physique*, **8**, p 485, 1927. *Phys. Zeit.*, **29**, p. 241; 1928) found two new lines for the elements tantalum (73), tungsten (74), platinum (78), and gold (79), and they also found that the values of ν/R for these lines corresponded approximately to those given by Bohr

LINE WITH SHORTER WAVE-LENGTH

Element	λ(A)	$\frac{\nu}{R}$ (Obs)	$\frac{\nu}{R}$ (Cal)					
	Thibaud and Soltan	Thibaud and Soltan.	$N_{IV}\ N_{VI}$	$N_{IV}\ N_{VI,\ VII}$	$N_{IV}\ O_{II,\ III}$		$N_{IV}\ O_{I}$.	
			Idei	Bohr and Coster	Idei	Bohr and Coster	Idei	Bohr and Coster
Ta (73) .	58 3	15 6	15 9	15 5	15 0	15 4	12 6	12 7
W (74) .	56 0	16 3	16 4	16 2	16 0	15 8	13 3	13 5
Pt (78) .	48 0	18 9	18 8	19 3	20 2	15·9	16 8	17 4
Au (79) .	46 8	19 5	19 6	20 0	21 7	18 1	18 2	18 6

LINE WITH LONGER WAVE-LENGTH.

Element	λ(A)	$\frac{\nu}{R}$ (Obs).	$\frac{\nu}{R}$ (Cal)					
	Thibaud and Soltan.	Thibaud and Soltan	$N_{V}\ N_{VI,\ VII}$		$N_{V}\ O_{II,\ III}$		$N_{V}\ O_{I}$	
			Idei	Bohr and Coster	Idei	Bohr and Coster	Idei	Bohr and Coster
Ta (73) .	61 4	14 8	15 0	14 7	14 0	14 6	11·7	11 9
W (74) .	59 1	15 4	15 4	15 3	14 9	14 9	12 2	12·6
Pt (78) .	51 0	17 8	17 8	18 0	19 0	14 6	15·6	16·1
Au (79) .	49 4	18 4	18 4	18 6	20 4	16 7	16·8	17 2

and Coster for $N_{IV}\ N_{VI\ VII}$ and $N_{V}\ N_{VI,\ VII}$ respectively, but, due to the inaccuracy of the values for the energy levels, especially for the O_{I} and $O_{II,\ III}$ levels, they were not able to reach any definite conclusions. In a later paper, however, Thibaud (*J.O.S.A. and R.S.I*, **17**, p. 145; 1928) ascribes the origin of the two new lines to transitions between the O (probably $O_{II,\ III}$) level and the N_{IV} and N_{V} levels.

I have recently made some careful measurements in the L-series, the results of which make possible a more accurate determination of the values of ν/R for the levels in question. These values, as well as those of Bohr and Coster, are given in the table above with the values of ν/R for the two newly discovered lines. Judged from these new values, it would seem just as likely that the doublets found by Thibaud and Soltan are due to the transitions $N_{IV}\ N_{VI}$ and $N_{V}\ N_{VI,\ VII}$ This would then be the first experimental evidence of X-ray transitions within levels of the same principal quantum number.

SAKAE IDEI.

Physical Laboratory, Upsala,
Mar. 7.

Combustion of Rigidly Dried Carbonic Oxide-Oxygen Mixtures.

THE paragraph in NATURE of April 13, p 584, referring to my paper on "The Combustion of Well-dried Carbon Monoxide and Oxygen Mixtures" in last month's *Proceedings of the Royal Society*, contains a statement which, if allowed to pass uncorrected, might convey a wrong impression.

It is scarcely true to say that our previous experiments on the combustion of six-months phosphoric anhydride dried mixtures of carbonic oxide and oxygen had been criticised "on the grounds that inadequate precautions had been taken to remove occluded hydrogen from the platinum electrodes between which the igniting spark was passed," although it may be that in NATURE of Sept 24, 1927, Prof H. E. Armstrong had queried whether possibly "hydrogen, imprisoned in the platinum electrodes" had been "extruded into the gas"

In describing, in my recent paper, our further experiments—the object of which was to test whether a prolongation of the phosphoric anhydride drying up to 550, 750, or even 1000 days (instead of the former 170-220 days) would make any difference to the results—I was careful to explain (1) that, in all the previous experiments, the electrodes had been 'glowed out' repeatedly in a high vacuum for many hours (at least 20 in all), so as to remove occluded hydrogen from them, and (2) that, in the further ones, the additional precaution had been taken of electrically 'glowing out' the electrodes in oxygen at low pressure, as well as in a high vacuum, both of which operations were continued many hours

I do not think there can be any reasonable doubt of the adequacy of the measures taken in the previous experiments to remove occluded hydrogen from the platinum electrodes; in the later ones, the further precaution referred to was taken merely 'to make assurance doubly sure'; and, seeing that the results of the two series did not differ in any material respect, the adequacy of all precautions in both is assured Indeed, the fact that in both series condenser discharge sparks of anything up to 0 5 microfarad at 1000 volts were repeatedly passed (between platinum-balled electrodes) through the phosphoric anhydride-dried medium, without even the faintest sign of ignition being discernible photographically, may be regarded as a conclusive test, not only of its extreme dryness, but also of the total exclusion of hydrogen from it.

The experimental results now enable us to say quite definitely (1) that a highly purified $2CO + O_2$ mixture which, under all necessary precautions, has been rigidly dried to the utmost limit possible with re-distilled and highly purified phosphoric anhydride, will still explode and propagate flame provided that a sufficiently powerful igniting spark is used, and (2) that with platinum-balled electrodes the minimum condenser discharge spark required is about 0 75 microfarad at 1000 volts (energy = about 0 75 Joule)

WILLIAM A. BONE.

Imperial College of Science and Technology,
London, April 16.

Titanium Oxide Bands in the Orange, Red, and Infra-Red Region.

BANDS in the region of λ5600 to λ8000 have been analysed into at least two systems, distinct from that of the blue-green region, previously analysed by Birge and Christy (*Phys. Rev.*, vol. 29, p 212, 1927. Abstract. NATURE, vol. 122, p 205; 1928) One of these in the orange is a singlet system due to the electronic transition $^1P - {}^1S$, the other a triplet system in the red and infra-red due to the transition $^3S - {}^3P$. Of the former only one sequence has yet been found; of the latter, four have been determined, namely, the (0, 1), (0, 0), (1, 0) and (2, 0), the $\Delta\nu$ separations of the triplet heads of the (0, 0) sequence being 66·7 and 74 6 cm.$^{-1}$ respectively

The molecular constants, determined from the vibrational analysis of the triplet system, show that in the final state the vibrational frequency of the rotationless molecule with infinitesimal amplitude of vibration is the same as in the blue-green system, and that thus their final energy level, ^3P, is the same. Further, since the separation of the triplets of red-infra-red system pertains to this final level, it pertains also to the final level of the blue-green system.

Analysis of the other bands found in the red is in progress.

F. LOWATER.

Imperial College of Science,
South Kensington,
Mar. 28.

Ozone Absorption during Long Arctic Night

I HAVE been trying for the past ten years to interest the astronomers in having photographs of stellar spectra made during the long arctic or antarctic night, on the chance that the ultra-violet cut off due to ozone may be less powerful, and I mentioned it to Prof Russell last spring I have always emphasised the importance of choosing a station so situated that there will be a minimum chance that ozone formed in the illuminated regions will be carried over into the dark region by atmospheric circulation. Information regarding the direction and velocity of the upper atmospheric current will be necessary in choosing the site It should certainly be nearer the pole than the station occupied by Prof. Rosseland (NATURE, Feb. 9, p. 207), for the sun at noon was only three or four degrees below the horizon, and the air five miles above the surface was in full sunlight, as Prof Russell pointed out to me. His negative result I do not regard as decisive, though I am not very hopeful that much or any extension of the spectrum will be found, as ozone is fairly stable An objective prism pointed at the pole star seems the simplest device.

R W. WOOD

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Lengthened Chain Compounds of Sulphur with Platinum.

IN NATURE (Jan. 22, 1927, p 124) a lengthened chain compound of sulphur of the formula $BrC_2H_4.(SC_2H_4)_{48}Br$, as also another of sulphonium sulphur having so high a molecular weight as 3472, have been described.

Recently, in collaboration with K C. Bose-Rây, I have prepared another series of complex sulphur-platinum chain compounds (*Zeit anorg. Chem*, Bd. **178**, p. 329; 1929) the first member of which has the formula Pt_3Cl, $2(C_2H_5)_2S_2$, $2NH_3$, $6H_2O$, and the last $Pt_{13}Cl$, $10(C_2H_5)_2S_2$, $2C_2H_5NH_2$, $8H_2O$, with a molecular weight as high as 4050·5 This is perhaps the only example as yet known of a metallic compound synthesised in the laboratory and possessing such a high molecular weight

P. C. RÂY.

University College of Science and
Technology,
Calcutta, Mar. 13.

Science and Hypothesis.

By Sir Oliver Lodge, F.R.S.

RECENT speculations in mathematical physics, and acquiescence in treatment in terms of unimaginable abstractions, have raised a general question about the use of hypothesis as a means of coordinating observations, stimulating experiment, and paving the way for a theory. It is possible to experiment not only in the laboratory with matter, but in the study also, with symbols; and a great deal of modern mathematics is of an experimental character. A hypothesis is boldly made, some indication of its plausibility having been detected by a flash of genius; it is then developed and its consequences worked out. If the consequences are evidently leading astray, it is abandoned; but if like Planck's, like de Broglie's, and like Bohr's—to go no further—they lead in a helpful direction, yielding results that can be compared with metrical determinations, then the hypothetical formula attracts attention and begins to be accepted as the basis of a partial theory, even though its full significance is not understood, the reasons for it only dimly apprehended, and though the agencies with their mode of working are in the main unknown.

Experience has shown that a working hypothesis may be a true guide so far as it goes, even though it has in the end to be so extensively supplemented as to be revolutionised. The precision attainable varies in different branches of knowledge: only in a few subjects can the results be expressed and checked with numerical accuracy. In physics and astronomy we have grown accustomed to these precise modes of verification, though even here the verification may not substantiate every detail of the original hypothesis or prevent its complete recasting in the light of further knowledge. The quantum was appealed to as somehow securing the stability of Bohr's electronic orbits; but further treatment by Schrodinger put a different complexion on the electron; and the final word has not yet been said. Still, the quantitative results attained by Bohr's theory, spectroscopically verified to many places of decimals, were amply sufficient to justify us in enthusiastically welcoming the partial clue provided.

Not often is such numerical precision attainable; sometimes only the order of magnitude can be checked, and sometimes the agreement with fact is not quantitative at all. Even in chemistry the constitution of certain molecular compounds was arrived at by a special instinct, and was accepted long before physicists began to scrutinise the molecules and ascertain that their constitution was more or less in accord with the intuitions of genius. In biology such direct verification is still far off, and seldom can any theories be brought to the test of quantitative determination. In anthropology and sociology, in addition to all the other difficulties, an element of caprice enters in. Humanity is not so amenable to law and order as molecules are, and individual behaviour can scarcely be predicted or specified with anything approaching completeness. A statistical result may be arrived at, and the average behaviour of a large group can be stated with approximate correctness, subject to disturbing causes. Even in molecular physics the laws of probability tend to supersede the accurate dynamics of individual occurrences, and we have to be satisfied with a sort of average uniformity variegated and enlivened by individual eccentricities.

Psychologists and psychiatrists seek to penetrate the meaning of perverse peculiarities, and to ascertain the laws of individual behaviour so far as they can. The introduction of what we call chance and caprice makes a scientific treatment more difficult, undoubtedly, but it does not prevent the subject from being pursued in a scientific spirit. Methods and results must vary according to subject matter; and what would be vague in physics and chemistry may be unusually definite in subjects like biology and psychology. Even in physics an element of indeterminism has recently been suspected: certainly the molecules of a gas are behaving in an apparently lawless manner, while yet their average or aggregate behaviour on a large scale is satisfactorily uniform.

As to the illegitimacy of hypothesis in science, that is absurd. Every theory began as a hypothesis. It is to test a hypothesis that every elaborately planned experiment is made. As a digression it may be worth insisting that Newton himself constantly made hypotheses,—his queries at the end of "Optics" are a collection of them,—and gravitational astronomy itself must have begun as a hypothesis. When engaged in deductively working out results of theory on a mathematical scheme, he did indeed, and very properly, say, "I am not making hypotheses," using the present tense in a perfectly grammatical and intelligible manner; though the sentence is often mistranslated or misinterpreted in a form covering both past and future, as if he had said, I do not make, or I never make, hypotheses. Which would have been merely false.

The ether of space is a hypothesis; rendered necessary by the complex behaviour and properties which have to be attributed to what we call empty space, that is, space empty of matter. Regarded philosophically it seems impossible to imagine the space between atoms and worlds as really empty; it is only empty of everything that appeals to our senses and is amenable to direct experiment. The nature of space is inferred, and has to be inferred, from its effects on matter; but the inference that there must be something literally 'sub-stantial' in space, which is really responsible for cohesion, elasticity, and all the other manifestations, is inevitable; though in expressing such behaviour (electrical, optical, gravitational) it is the results and not the mechanism that we formulate, for the mechanism seems to be unlike any mechanism with which we are acquainted, and is still essentially unknown.

Objections to the ether are really objections to the nineteenth century conception of an ether expressed

in terms of mechanical models No such ether exists the real ether is too fundamental an entity to be expressed in terms of the sensory perceptions of material behaviour, which is what we usually mean by explanation. In so far as it is unexplained and not amenable to experiment—so long as it is a sort of hypothesis *in vacuo*—the ether may be disliked, just as Newton disliked the introduction of vague and ill-understood causes, preferring to have none at all to account for action at a distance rather than some entity of which he neither knew nor could ascertain anything. Electricity and magnetism were a sealed book then, and Clerk Maxwell was far in the future

There are, however, sciences of which the working hypotheses must be vague. The mental sciences are peculiarly in that condition, we cannot treat of mind in any quantitative manner. The trivial details of experimental psychology skirt about the fringe of the subject, collecting data rather like those of old-fashioned meteorology, in the hope that perhaps some day a comprehensive generalisation will arise which can reduce them to law and order

All this preliminary is for the purpose of (perhaps unnecessarily) insisting that science exists in many stages of development; and that we are not at liberty to turn down a nascent science merely because it is still in an infantile and unmetrical or even a capricious condition. Human activities cannot be denied merely because they are inaccessible to calculation and defy prediction

To take an extreme example What is called the spiritistic hypothesis is flagrantly objected to, for it appeals to the activities of unknown agencies which cannot at present be satisfactorily brought to book. The supposed agents have human characteristics, and behave as if they were like ourselves, except that they are for the most part out of touch with matter, save under special conditions which it is our business to investigate if we can, whereas we ourselves, when acting as agents, are not only conscious mental and spiritual entities, but are closely and continuously in touch with matter for a period of the order of a century Our action on matter makes our behaviour conspicuous and easy to observe, but it has not yet led to any explanation The connexion between mind and matter is still an unsolved problem, the mechanism of it is only very partially understood—the link between mind and brain is missing,—but that does not prevent our accepting the activities of, say, engineers and architects and artists as a fact They do deal with matter, in accordance with their plans and designs, whether we understand the process or not

So if hereafter we find ourselves still existing and active, after we have escaped from our normal organism,—if it turn out that under certain conditions we are able to use the organisms of others, so as still to affect material particles, especially the complex molecules of living protoplasm, and thus display surviving intelligence,—we should hope to be met, not by an *a priori* objection as to the possibility of such activity, but rather by a willingness to study the evidence and a determination to be guided by the facts, as in any other better established and more reputable branch of inquiry

Still, it does happen that even after some prolonged and impartial study of the facts, the hypothesis of what may be called posthumous activity is still disliked and still provisionally rejected as an attempt at explanation For example, my distinguished friend, Charles Richet, accepts all the phenomena that I do, or even more, but the tentative explanation of some of them as due to discarnate activity does not appeal to him, or perhaps I should rather say is only very gradually beginning to appeal to him And there are other less well-known members of the Society for Psychical Research who stand out against the spiritistic view and strive after every other sort of explanation,—thereby doing good service and constraining a supporter of the hypothesis to bring forward constantly better and better evidence and to realise more clearly the objections that have to be met

Again, I suspect that contributors to Nature, and the majority of its readers, regard both the hypothesis and the phenomena which led to it with serious doubt and unconcealed dislike, some indeed pour contempt on the whole thing as a savage superstition. But the occurrence of the phenomena amid all races and in all periods, though it may arouse prejudice, is no valid argument against the reality of something responsible for those widespread superstitions Our business is to disentangle them from superstition and to dissect out whatever element of truth they may enshrine. For it has been our experience that an element of truth often does underlie old legends Explorers often discover that old beliefs had a foundation after all, witness Schliemann at Troy, Sir Arthur Evans at Crete, and many other examples known to archæologists and palæographers An ancient belief can scarcely give any appreciable support to a scientific hypothesis, but the existence of such belief is not really injurious and is by no means fatal to it. On the whole, the existence of a tradition is rather favourable than otherwise At worst it is neutral.

Objections to the Spiritualistic Hypothesis from a Scientific Point of View

With this preliminary let me comment on a sentence extracted from a paper which will shortly appear in the *Proceedings of the Society for Psychical Research*, in which an automatic writer who himself has produced script purporting to be inspired by a fairly recently deceased and comparatively unknown poet, expresses himself as sceptical about the ostensible and superficial significance of the scripts in the following words —

> " . . Regarded as a scientific working hypothesis, spiritism does not seem to me to be a very hopeful avenue of investigation. The spirit hypothesis has a delusive appearance of simplicity, but so also had Kepler's hypothesis of guiding angels. And how remote this was from the complex reality of Einstein's description of gravitation! In fact, if these supernormal mental phenomena depend on the whims and caprices of departed spirits, then I for one despair of ever being able to discover any law and order in them."

Undoubtedly there is some difficulty, in our present state of comparative ignorance, about specifying or formulating the spiritistic hypothesis in any precise and, so to speak, scientific manner, for it is an appeal to the activity of unknown agents acting by unknown methods, under conditions of which we have no experience, and by means of which we are unaware. We get into touch, or appear to get into touch, with these agencies only when they have affected material objects, for example the brain, so as to produce results which appeal to our normal senses. But the admission that we cannot understand how agents work does not justify our denial of the existence of such working. As I have already hinted, a good deal of modern mathematical physics is in the same predicament. We do not really understand how the properties of the ether, or of what it is now the fashion to call 'space-time,' act in producing the material effect we call weight or gravitation. We know a good deal about it; we can specify with precision the law of 'weight' in so far as it imitates the resultant of an independent and unscreened attraction of every particle for every other. We can say that the earth acts nearly as if its whole mass were concentrated at its centre, that the law of force is different inside and outside, so that it changes abruptly when the surface is penetrated, and that the force attains a peak value at the surface, sloping down differently on the two sides. We can speak of the state of strain or 'potential' to which the force is due, say that it is continuous across the boundary, give the law of its variation with distance, and so on.

Newton, in fact, correctly formulated the whole theory of gravitation considered as action at a distance; but the true mechanism of what seems like a condition of strain or warp in space, brought about by the very existence of matter, was beyond him, as it is still beyond us. In philosophic mood, Newton was never satisfied with his mode of specification. It merely gave the resulting effect of something that simulated the direct attraction of one body on another across apparently empty space; he had to leave the inner meaning of such mysterious action for future discovery.

Einstein discarded the attraction or force exerted by a body at a distance, and replaced it by a geometry of space which would account for, or at least express, the resulting behaviour in a more intimate and, so to speak, less magical manner. An inert body can only be perturbed or guided by something in immediate contact with it, even though the particular modification of that 'something,' which enables it so to act, may be due to the neighbourhood of a distant mass of matter, for reasons which remain to be explored.

The fact that we sometimes have to postulate an unknown agency does not justify our attributing anything capricious to that agency. We are ignorant of how the gravitational agent acts, but we know that it acts in accordance with law and order, so that the results can be duly predicted. Einstein's view (if we may call it Einstein's, though in one form or another it must have been vaguely held by many) is after all *not* so very different from Kepler's asserted hypothesis. What Kepler meant by "guiding angels controlling the planets" (assuming that he used that phrase) I do not know, but I am sure he meant nothing capricious. He must have meant that an unknown something guided the planets in their path; and that is a paraphrase of the modern view. The 'something' is now often spoken of as a warp in space. In so far as Kepler postulated something in immediate touch with a planet and acting directly on it, he had what now appears to be truth on his side; his thesis being perhaps nearer the ultimate truth, though far less practically useful, than Newton's delightfully simple quantitative expression for the indirect action of a distant body.

In order to illustrate direct guidance by contact action, we might take the familiar example of a gramophone needle, which automatically reproduces a prearranged tune, simply by following the path of least resistance. What else, after all, can an inert thing do? That is the meaning of inertia. Animated things are not inert; they need not take the easiest path. A man may climb the Matterhorn for fun. But inanimate unstimulated matter never behaves with any initiative or spontaneity; it is strictly inert. Atoms never err or make mistakes; they are absolutely law-abiding. If they make an apparent error, if a locomotive engine leaves its track, we call it a catastrophe. All machinery works on that principle; every portion takes the easiest path. It is true that to get a coherent result there must have been planning and prearrangement. Certainly! In all cases of automatic working, whether biological or other, that must be an inevitable preliminary. But explorers of the mechanism will detect no signs of mental action by their instruments or their senses. To infer a determining or controlling cause they must philosophise. Indeed, we may go a step further, and emerge from the past into the present, thus: A wireless set talks like a gramophone, and to one accustomed only to gramophones it would seem barbarously superstitious to urge that in the wireless case some (possibly whimsical and capricious) operator was actually in control. Statements may be unpalatable, and yet be true.

Now return to gravitation. Planets behave as if they were attracted by the sun. That is certainly true. But what is attraction? A train is not attracted to its destination; lightning is not attracted to a chimney; but it gets there none the less, by continually taking the easiest path. So it is with a planet. Indeed, one might say that everything inert takes the only path open to it, it has no option. The law is a sort of truism. But the principle, once recognised, has been formulated into a clue; the Principle of Least Action can be expressed mathematically. Once postulate that, and the behaviour of the inanimate portions of the cosmos can be accurately deduced.

The modern statement that the planets move along the line of least resistance, or the easiest path, makes their motion rather closely analogous to that of a railway train guided by the rails. The path and destination of a train are determined by the

continual direct influence of the rails, which make it easier for the train to travel in the right direction than to jump them and go astray. We might, if we chose, admit that the path was laid down or determined by the mentality of the surveyors and designers of the route, but a Martian spectator with partial information might still wonder at the apparent intelligence which guided one part of a train to Manchester, and another part to Liverpool, in accordance with the wishes of the passengers or the labels on the coaches If told that an invisible guardian angel switched over the points to produce this result, he might resent the suggestion as absurdly unscientific and preposterous, as on a purely mechanistic view it would be.

After having studied trains for some time, our spectator might begin to notice the novelty of a motor-car His first tendency would be to look for the rails in that case also, and, finding none, he might superstitiously but correctly surmise that a guardian spirit was guiding the car to its destination In this case, moreover, further experience would soon persuade him that he had to allow for an element of caprice But even that is not fatal to the truth he need not throw up his hands in despair. As soon as we introduce the activity of life and mind we get out of mere mechanism, and the results are not easily formulated or predicted The activities of an animal cannot be expressed in mathematical terms, and yet animal instincts and behaviour are subject-matter for scientific investigation. It is assumed that they obey laws of some kind

Science is not limited to the accurate data and laws of mathematical physics. and to claim that a hypothesis is unscientific because we cannot formulate it completely, or because we do not understood the method of working, or even because there is a certain amount of capriciousness about it, is more than we have any right to claim Anthropology and sociology are less advanced sciences than physics and chemistry, they have to get on as best they can, with a profusion of data, and with the inevitable complications appropriate to live things Let us not be put out of our stride by the fear of retaining, in modified form, some of the animistic guesses of primitive man Experience may lead us, as it led him, to contemplate stranger modes of existence, and more whimsical phenomena, than our long study of mechanism has led us to expect We must put aside prejudice, be guided by the evidence, and strive for truth The superficial simplicity of materialism has served us well, as a comprehensive covering, for three centuries, and we have made good progress under its protection, but it is beginning to be threadbare and inadequate, it is not co-extensive with reality, and unsuspected influences are peeping through

To sum up A working hypothesis can be followed and developed rationally, without being metrically exact in its early stages The important question about the spiritistic hypothesis is not whether it is simple or complicated, easy or puzzling, attractive or repellent, but whether it is true Its truth can be sustained or demolished only by the continued careful critical and cautious method of inquiry initiated by the S P R under the presidency of a guiding spirit or guardian angel called Henry Sidgwick, with the active (and I believe continuing) co-operation of Edmund Gurney and Frederic Myers.

The Supply and Therapeutic Uses of Radium.

By Prof. S Russ, The Middlesex Hospital

THE law of supply and demand is as true for radium as other commodities Production has often almost ceased owing to lack of demand, only to be renewed as the demand returns, while sudden demands have sent up the price to prohibitive levels until either competition or diminished requirement has brought it down again

The three main sources from which radium has been mined on any scale are Czechoslovakia, the United States of America, and the Belgian Congo, Cornwall and Portugal have also been producers, though on a smaller scale The low grade of the carnotite deposits in U S A made it impossible for America to compete with production from the large deposits of pitch-blende located by the Union Minière du Katanga in its property in the Congo since this rich source has been developed Czechoslovakia still produces radium, and in Great Britain there is very little difference in the price of radium coming from there or from the Belgian Congo Unless the amount bought is as much as several grams, the price is at present £12 per milligram of radium element, with extra charges for certificates of measurement and other services connected with the supply This price is doubtless one which yields a very big profit to the producers, and it is worth while mentioning that the price of the Belgian radium is graded according to the national purse of the buyer—Britain pays more than do her continental neighbours, and America pays more than Britain There is radium enough in the earth for the world's needs if it can be paid for

The therapeutic uses of radium are mainly in connexion with cancer, though it is also used for certain other conditions and some dermatological diseases. The outstanding medical interest in radium-therapy is in determining its value and the best methods of application in the treatment of cancer

Radium-therapy has gone through several phases In its earliest years, about 1900, success often attended its use in superficial cancers of low malignancy, this was followed by attempts at dealing with internal growths by implanting radium in platinum or other metal tubes into them Dominici from 1909 onwards insisted on the necessity of avoiding the use of easily absorbed beta and gamma rays when radium was actually inserted into the tissues, and said that only " les rayons ultra-pénétrants " should be used

By the year 1914 radium-therapy had already made some progress The principle of selective action was recognised, and there were several laboratories where the effects of the rays on normal and malignant structures were being investigated. All this work received a set-back during the years of the War, but the ten years that have passed since have been a time of great activity and progress in the subject

France is the home of radium-therapy (Curie-thérapie they prefer to call it), and it is in no small part due to the systematic researches carried out at the Institut du Radium in Paris, organised by Prof Regaud, that radium-therapy has reached its present phase This phase is one in which the definite gains of the past give rise to the belief that radium may be looked upon as a means whereby certain localised growths of cancer can be removed as surely as, and generally with less danger than, by surgery This is a big claim, and it is one now generally acknowledged, but it cannot seriously be suggested that radium is a cure for generalised cancer Although a primary localised growth often disappears with radium treatment, in cases where the disease has already spread to glands it is generally true to say that the disappearance of growth in one part of the body has little recognisable effect upon the spread of the disease outside the range of action of the radium

One of the most important principles that has been recognised during the last five or six years is the significance of the time factor It is certain that the effect of radiation upon a tumour depends not only upon the dose of radiation absorbed by the tumour and the surrounding normal structures, but also upon the time over which the radiation is spread This is nowhere exemplified better than in the treatment of cancer of the tongue For many years these growths, often heavily infected with bacteria, were the despair of those who attempted to treat them by inserting one or two radium tubes, containing perhaps as much as 50 milligrams of the element, and leaving them *in situ* for twenty-four hours With this treatment it often happened that the local condition was actually aggravated Since the treatment has been altered and a number of smaller tubes containing only a milligram or two have been inserted and allowed to remain for a week or ten days, so great has been the improvement in the results that, to-day, radium combined with surgery is looked upon as the most suitable treatment for cancer of the tongue and buccal cavity.

An explanation of this difference in biological reaction has been sought on various lines, for while some think that it lies in the greater probability of cells in the vulnerable state of division being irradiated in the longer exposure, others believe that cell growth is more affected by prolonged than by short period irradiations, while the opinion is also held that the effect is largely due to the ability of the host to support a low intensity of radiation more easily than a high one It must not be lost sight of, however, that the two types of treatment are fundamentally different in the distribution of the radium in the tissues In the second case the radiation of the region involved is much more uniform and there is more prospect of treating the whole of the growth than in the first case, where one or two tubes containing a large quantity of radium are embedded This distribution necessarily gives a much too heavy dose to the tissues surrounding the tube, while at the same time much of the growth may be outside the lethal range of action

Radium is now an acknowledged agent in the treatment of localised cancer, and every year new methods are being devised in order to deal with the more inaccessible varieties of growths (for example, stomach, œsophagus, brain, etc) But the radium in Great Britain is not enough to treat the numbers of cases of cancer who would probably benefit from its use It is true that the supplies, especially in the London area, have been considerably increased in the last five years, but in Great Britain generally there is a real shortage. From a national point of view, if an agent is known to be of remedial value in the treatment of any disease, then it would naturally be urged that it should be got, provided there are people enough who know how to use it to the best advantage These two objects are doubtless in the minds of those who have not only to gauge the nation's radium needs but also to find the means of satisfying them It is unthinkable that Great Britain cannot really afford the radium that it requires, but the administration of a quantity, let us say a gram per million of population, calls for a good deal of consideration in medical economics Is the present moment the time for starting a radium centre on the broadest lines where treatment, research, and the teaching of therapy can be carried out ? Would it be better to supplement the resources of centres in Great Britain which have already earned a certain reputation ? Or would it be better to aim at putting the technique of radium-therapy into the hands of the general practitioners of the country ?

The final result, in so far as the economic and efficient treatment of cancer by radium is concerned, is very largely bound up with the decisions of a national character which are likely to be taken in the near future

In the House of Commons on April 16, Mr. Winston Churchill announced that the Government has arranged for the publication of the report of the Sub-Committee of the Committee of Civil Research on Radium This Sub-Committee, under the chairmanship of Lord Rayleigh, expressed the opinion that in order to meet the medical requirements of England, Scotland, and Wales, twenty grams of radium should be acquired before the end of 1930 It also recommended the election of 'National Radium Trustees' whose duty it should be to hold the funds provided and to purchase and hold radium for the use of an expert body, this expert body to be called the 'Radium Commission' Mr Churchill further stated that the Government has accepted the financial recommendation of the Sub-Committee and that it will be prepared to contribute from public funds, up to a maximum of £100,000, to the extent of £1 for every £1 of private subscription.

Obituary.

Sir George Knibbs, C M G

BY the death of Sir George Handley Knibbs at Melbourne, on Mar 30, science in Australia has lost one of her most forceful and enthusiastic workers

Sir George was born in Sydney in June 1858 As a surveyor and civil engineer he took an active part in the topographical survey of New South Wales He then became acting professor of physics at the University of Sydney In 1906 he was appointed Commonwealth Statistician, and in that capacity brought out the Commonwealth Year Book, which, by reason of its comprehensive and accurate nature, is one of the best statistical publications in the world

After serving for fifteen years as Commonwealth Statistician, Sir George Knibbs was appointed in 1921 Director of the Commonwealth Institute of Science and Industry, which post he held until his retirement from public life in 1926. The Institute was then reconstructed as the Council for Scientific and Industrial Research While under his direction, the small staff of the Institute commenced a number of important lines of investigation, some of which have recently passed from success in the laboratory to the sphere of commercial scale tests These included research into the manufacture of paper pulp from Australian hardwoods, power alcohol production, the eradication of prickly pear, and the utilisation of Australian pottery clays Knibbs deplored the inevitable whittling away of funds intended for research purposes, due to political indifference, which lessened the value of the Institute to the nation The constitution of the Institute, however, did not favour its fullest co-operation with the universities and other State bodies, nor did the somewhat autocratic manner of the director attract his Australian fellow scientific workers Both features were undesirable in a national research body.

Throughout his public life Sir George Knibbs took an active part in social legislation and served on Royal Commissions concerned with education, social and other forms of insurance, taxation of crown leaseholds, trade, and industry. As Commonwealth Statistician, he devised the mathematical formulæ on which the Commonwealth land and income taxes are assessed

Though his activities were more of an administrative nature, Sir George contributed to the scientific press numerous monographs on pure mathematics, geodesy, and geodetic instruments His larger contributions include "The Mathematical Theory of Population," "The Census of Wealth," and a recent book, "The Shadow of the World's Future"—a study of the relation of world population growth to food production and migration influences From a statistical basis, he emphasises the need for modification in national policies to avert the danger of over-population

Sir George Knibbs was a fellow of the Royal Astronomical Society, an honorary fellow of the Statistical Society, and a member of the International Institute of Statisticians He attended many international congresses, where his sound knowledge of foreign languages, backed by a comprehensive grasp of scientific affairs, made him an able and worthy representative of the Commonwealth Although in recent years his health was failing, this disability seems to have had little effect on the keenness and brilliance which he applied to the welfare of Australian scientific organisations The knighthood bestowed on him in 1923 was regarded in Australia as a fitting recognition of the devoted and brilliant service he had rendered to his country

Sir Henry Rew, K C B

THE death at his house at Wormshill, Kent, on April 7, at the age of seventy years, of Sir Henry Rew removes a leading authority on agricultural economics and, in the old sense of the word, statistics For some years prior to 1906 he was in charge of the Statistical Branch of the Ministry of Agriculture and Fisheries, and after his promotion in that year to the post of assistant secretary, his predominant interest lay in the annual reports on agricultural statistics, for which he was personally responsible To his work in this field is largely due the fullness and comparability of the series of returns on British agriculture His initiative may be exemplified by the estimates made by a committee of the Royal Statistical Society, from returns from representative dairies and slaughter-houses of the production of milk and meat in the British Isles

The two addresses given by Sir Henry Rew as president of the Royal Statistical Society were devoted to "The Organisation of Statistics" and to "The Progress of British Agriculture." In the first of these he emphasised that "The real question . . is not the present defects of the official statistics or the delinquencies of official statisticians, but the deficiencies of the present system and the inadequacy of the available resources" After quoting the several high authorities who at different times had urged the importance of the establishment of a centralised statistical department, he expressed his own conviction of the need for "a general overhaul of official statistical machinery, and for some drastic measure for securing co-ordination" The function of the Royal Statistical Society should be to assist in forming an appreciative, watchful, and well-informed public opinion

Sir Henry's second address to the Royal Statistical Society was largely a historical account of agricultural statistics leading to the important conclusion that while the statistical data were unable to prove the case, an examination of the statistics so far as they were available pointed to the conclusion that a larger quantity of food was being produced at the outbreak of War than at any previous period, and this in spite of a shrinking acreage.

Mr C E Benham

Mr Charles Edwin Benham, of Colchester, whose sudden death on April 1, at sixty-eight years of age, we regret to record, was a representative of the type of scientific amateur of which British science has reason to be proud He followed scientific pursuits, and studied natural processes and events, purely for the love of Nature in all her ways, and by faithful observation and original mind he was able to make some notable contributions to knowledge

Mr Benham was for many years editor of the *Essex County Standard* and spent most of his life in the town of Colchester, where he took a leading part in educational and other movements It is not surprising that "William Gilbert of Colchester" should have attracted his literary and scientific attention, for Mr Benham's methods were of the same experimental and independent character as those of Queen Elizabeth's learned physician In an excellent little book published in 1902 he showed what manner of man Gilbert was, wherein lay his genius, and the spirit of his work, which was "that all scientific knowledge must be founded on practical experiment and observation alone, instead of upon speculations and theories evolved out of inner consciousness"

In 1895 Mr Benham devised a colour-top by which a curious optical illusion is produced which is not easy to explain Half of a white cardboard disc is coloured black and on the other half a number of black lines are drawn as arcs of a circle On rotating the disc, and viewing it in a bright light, the arcs of some of the circles appear coloured On reversing the rotation the order of the colours reverses The subjective colour effects then exhibited were the subject of a number of letters in Nature at the time the top was produced, and Mr Shelford Bidwell devoted a paper to them which was published in the *Proceedings of the Royal Society* of Dec. 17, 1896

On the experimental side also, Mr Benham developed the twin-elliptic pendulum and published a number of papers on harmonic vibrations and vibration figures. He was the author of many communications published in Nature, *Knowledge*, *Science Progress*, *Engineering*, and other scientific journals, and the subjects covered a wide range of practical inquiry, including thermographs, atmospheric electricity, electroscopes, alarum sundials, and iridescent glass Mr Benham was in addition an artist whose water-colour drawings are of real distinction, and the author of works on local Essex dialects and the history of Colchester He was an ardent lover of knowledge in all its highest aspects, and his death will be regretted by a wide circle of students who have been stimulated by his work, as well as by his numerous personal friends

Prof F. Kehrmann

Dr. Friedrich Kehrmann, professor of organic chemistry at the University of Lausanne, died on Mar. 4 We are indebted to the *Chemiker-Zeitung* for the following details of his career Born at Coblenz in 1864, Kehrmann became deeply interested in chemistry while still a boy, but being at first unable through lack of means to attend regular classes, he studied by himself He became so proficient in analytical work that he obtained a post as analytical assistant to Fresenius at Bonn In 1887 he graduated at Basel under Nietzki, with whom he carried out an investigation of quinones. After graduation he became assistant to Claus at Freiburg, where from his observations upon di-ortho-substituted quinones he formulated the well-known hypothesis of 'steric hindrance,' a generalisation which has been very extensively applied in the study of other branches of organic chemistry

Kehrmann's hypothesis was based upon the hindering effect of two ortho-substituents upon oxime-formation, and in support of his idea he quoted many other well-known examples of inhibited reactions, which had hitherto remained unexplained He was even able to foresee the discovery of steric hindrance in the ortho-substituted benzoic acids This prediction was verified shortly afterwards by the work of V Meyer, but for some reason or other Kehrmann's claim to priority seems to have been overlooked.

Kehrmann moved to Aix-le-Chapelle and thence to Geneva, where he found in Graebe's laboratory a congenial atmosphere and inspiring companions. At Geneva his chief interest was in dyestuff chemistry, to which he made many notable contributions, particularly in the field of azines, thio-azines, and oxazines To him may also be attributed the origin of the theory of the oxonium salts. For a short time he held a post with the firm of Casella and Co, but ill-health compelled him to relinquish it. Later he took up a teaching appointment at the Municipal School of Chemistry at Mulhausen in Alsace, and in 1910 he was appointed to the chair of chemistry at Lausanne. His collected works, which include the spectroscopic examination of whole classes of dyestuffs, have been published in five volumes.

We regret to announce the following deaths:

Mr W. Worby Beaumont, honorary consulting engineer of the Royal Automobile Club, for ten years a joint-editor of *The Engineer* and author of several well-known books on motor car engineering, on April 14, aged eighty years.

Prof. F. S. Earle, sugar cane technologist at the Tropical Plant Research Foundation at Herradura, Cuba, and president in 1906 of the American Botanical Society, on Jan. 31, aged seventy-two years.

Mr. Charles Hunt, an honorary member and past president of the Institution of Gas Engineers, aged eighty-six years.

Prof Clemens von Pirquet, professor of pædiatrics in the University of Vienna, known for his studies of the mathematical relationship of body measurements to nutritional requirements and for his cutaneous tuberculin reaction, aged fifty-four years.

Dr. Paul Sarasin, president of the ethnographical section of the Natural History Museum of Basle, on April 7, aged seventy-three years.

News and Views.

SIR ALFRED EWING, Principal and Vice-Chancellor of the University of Edinburgh, was presented on April 18 with the freedom of the City of Edinburgh in the Usher Hall in the presence of a large and representative assembly The honour was conferred, as stated in the Burgess Ticket, as a mark "of the high esteem in which he is held by the citizens of Edinburgh, in testimony of his valuable services to the city and the State, and in recognition of his brilliant and distinguished career as Principal of the University of Edinburgh during a period marked by exceptional difficulty on account of the War and the policy of unprecedented development and expansion of the University" The Lord Provost, Sir Alexander Stevenson, who presented the silver casket containing the Burgess Ticket, spoke of Sir Alfred's distinguished career, of his services to the University and his efforts to make the University a living force in the City, and of his work at the Admiralty during the War as creator and organiser of the department which achieved great success in intercepting and deciphering enemy wireless messages. In his reply, Sir Alfred referred to some of the important developments in the University during the thirteen years of his principalship, and at the end stated that he had received from Sir Alexander Grant a cheque for £25,000 and a promise of a like amount within twelve months for the building of a new department of geology. After the ceremony, Sir Alfred, accompanied by the president of the Students' Representative Council, was conveyed from the Usher Hall by way of Princes Street to the City Chambers in a gaily decorated open carriage drawn by students.

IN 1923 a large wooden building, which was erected in 1917 in St. Andrew Square, Edinburgh, for the use of American troops, was purchased by the University and rebuilt on the new campus near the southern edge of the City adjacent to the Department of Chemistry Early in the following year the Department of Geology was transferred thereto from inadequate premises in the Old College The wooden building is now approaching the limit of its existence, and Sir Alexander Grant's generous gift relieves an anxiety which was becoming acute as to the housing of the Department of Geology. This is the second benefaction the University has received from him, for about four years ago he contributed a sum of £50,000 towards the extinction of the debt on the Department of Chemistry. In June 1923 he gave £100,000 towards an endowment fund for the Scottish National Library, and in July of last year a further sum of £100,000 for the erection of a suitable building in which to house the Library He was also one of the chief contributors to the fund for the Scottish National War Memorial. His name, as Sir Alfred Ewing said, is in Edinburgh a synonym for generosity

WHEN a journal has been for thirty years in charge of one man, the reputation of the journal reflects the merits of the editor. The case in point is that of *The Mathematical Gazette* and Mr. W. J. Greenstreet. Founded and maintained in the interests of school teachers, the *Gazette* has pedagogy in plenty, abundant notes on scholarship mathematics, and reviews which endeavour conscientiously to appraise schoolbooks as they issue in bewildering streams from the publishers. But it aims also at helping its readers to understand how mathematics has grown since their own university days, and nowhere are important mathematical treatises subjected to more valuable analysis or more authoritative criticism. Keynes has been reviewed by Russell, Eddington by Newall, Weierstrass by Carathéodory, Schrodinger by Fowler, Knopp by Bromwich. While Mr Greenstreet has secured for a journal which grew out of the annual reports of a teachers' association the standing implied by such names as these, he has also poured into its pages a wealth of biographical and historical knowledge which has made the *Gazette* the most readable mathematical periodical in the world. A testimonial in appreciation of Mr Greenstreet's long and successful editorship has been organised by the Council of the Mathematical Association, which invites the cooperation of everyone who feels that such work as his deserves recognition Because of a severe illness which drained his resources two years ago, the testimonial is to take the form of a cheque, accompanied by the names of subscribers but not by a list of amounts. The expenses of the fund are being borne by the Mathematical Association, and the work involved has been undertaken by Mr. C. Pendlebury, 39 Burlington Road, Chiswick, London, W.4, to whom donations should be sent.

THE pioneers of New Zealand geology include von Haast, James Hector, F W Hutton, and Ferdinand von Hochstetter, the last of whom was born on April 30, 1829. The son of an Austrian pastor, Hochstetter took the degree of Ph D and in 1853 joined the Geological Survey of Austria. Four years later he became geologist to the famous *Novara* Expedition and on Dec. 22, 1858, arrived at Auckland, where his services were at once secured by the Government. Von Haast, the German geologist, had arrived the day before, having been sent out to report on the suitability of the country for German emigrants Together, Haast and Hochstetter carried out extensive geological explorations and both published works on the geology of New Zealand Returning to Europe in 1861, Hochstetter settled at Vienna and for many years held the chair of geology and mineralogy at the University there He died on July 21, 1884, and a memoir of him was written by Haast, which was reviewed in our columns on Nov 20, 1884

PROF E V APPLETON, Wheatstone professor of physics at King's College, London, has been awarded the Morris Liebmann Memorial Prize for 1929 by the American Institute of Radio Engineers This prize is awarded annually by the board of directors of the Institute to the worker responsible for the most important contribution made to wireless progress during the preceding year. Prof Appleton has for

some years been engaged in the study of the scientific problems of radio telephony, chiefly on behalf of the Radio Research Board and the Department of Scientific and Industrial Research. In 1924, working in conjunction with Dr. Barnett, he was the first to put forward acceptable experimental evidence for the existence of the so-called Heaviside layer and the value of its height above the ground. More recently, work on similar lines has been carried out under Prof Appleton's direction, in the most part at the Peterborough Station of the Radio Research Board, and at King's College, London, where wireless methods have been developed which have led to a great increase in our knowledge of the electrical properties of the upper atmosphere It may be recalled also that Prof Appleton made an announcement in NATURE of Mar 23 last, of the discovery of what is probably a second Heaviside layer He was recently awarded a Wireless Premium by the British Institution of Electrical Engineers for his researches on the causes of wireless signal fading and directional errors

A MOVEMENT to commemorate in an appropriate way the pioneer work of the late Mr W H Dines in the exploration of the upper air and in other branches of practical meteorology was initiated a few months ago by the Royal Meteorological Society The Council of the Society believes that the most suitable form of memorial would be the publication of a collection of Mr Dines's scientific papers in a single volume, and a circular has just been issued inviting promises of subscription to such a volume of about 600 large octavo pages, to be published at a price not exceeding thirty shillings. The papers consist almost exclusively of contributions to the publications of a number of scientific societies extending over a period of fifty years , and their re-issue in a collected form would not only be a tribute to Mr. Dines's original and fruitful work but also would be of real service to science in general and students of meteorology in particular Intending subscribers to the volume should communicate with the secretary of the Royal Meteorological Society, 49 Cromwell Road, South Kensington, S.W 7. We trust that the promises to purchase the volume when published will be numerous enough to relieve the Council of any anxiety which may be involved in the cost of publication of a work worthy of one whose researches began a new epoch in the history of meteorology and have led to developments of great practical value

THE American Association for the Advancement of Science held a very successful meeting in New York during the last week of December On behalf of the fifty educational and scientific organisations of the city, Prof Henry Fairfield Osborn, the president, welcomed the Association, which now includes more than 17,000 members, and gave an indication of the programme set for the meeting. A reprint of his address has now reached us. The programme seems to have been arranged with great regard to the convenience of the public and the scientific worker of wide interests, for separate days were set aside for general sessions each on one particular science, so that geology, physics, biology, chemistry, and anthropology each had its day, and on the evening of the same day a reception and address followed in the corresponding department of the American Museum of Natural History. Following the excellent precedent of the British Association, these evening addresses were of a semi-popular character designed to attract and stimulate the rapidly growing interest in science manifested in the city of New York and throughout the United States and Canada. "The leading *motif* of this science week programme was to offset some of the extreme specialisation of the present day by a more general prospectus of the unity and harmony of various sciences such as prevailed in the unified spirit of the great founders of the Association eighty-five years ago" It is a leading *motif* which deserves serious consideration in arranging the programme of the British Association. Advantage was taken of the occasion of the meeting to celebrate the centenary of the epoch-making glacial theory of Louis Agassiz, one afternoon session being devoted to a symposium of addresses on various aspects of glaciation

ONE of the interesting evening addresses was delivered by Prof. W. M Wheeler, of Harvard University, on "Present Tendencies in Biological Theory," and this has since appeared in the February *Scientific Monthly*. Prof Wheeler makes a strong protest against the critics of biological theory, who find that "biology has been steadily going to the dogs ever since the Renaissance," or that "biology has about reached a stage corresponding with pre-Copernican astronomy and physics, and that biologists have not yet discovered a single law, since what they have been fondly calling laws are merely rules or generalisations." He considers that there are at least three recent theories, which, with some mutual adjustment, might yield a provisional synthesis, or at any rate clarify the conflict between the mechanistic and vitalistic points of view. These are the theory of emergence or 'holism' propounded by Prof. S. Alexander, Prof. C. Lloyd Morgan, and General J. C. Smuts ; the configuration or 'Gestalt' theory , and behaviourism. Each of these theories deals with wholes, from different aspects ; the first emphasising that the whole has a novel import not apparent in any mere sum or aggregate , the second being more interested in the peculiar irreducibility of wholes as patterns either in space or time than in their novelty , and the third concerned with the action-patterns of the whole organism in response to its environment. While admitting that certain oppositions must remain in biological theory from the nature of the emergence levels of organisms, Prof. Wheeler thinks that many of the oppositions among theories may be elucidated and toned down "by the rejection of a lot of adventitious and mystical notions foisted upon the biological sciences by historians and philosophers."

AN outstanding feature in the recent history of the British Research Association for the Woollen and Worsted Industries is the retirement of the chairman, Sir James P. Hinchliffe. Sir James, who is well known for his public services in Yorkshire, is a

distinguished figure in the textile industry, and he has, in large measure, been responsible for the development of the present high degree of efficiency of the Association. He is succeeded by Lord Barnby, who, in addition to being governing director of one of the largest wool firms in the world, has already rendered much service through the Federation of British Industries and elsewhere, by his advocacy of the importance of the application of scientific method in the development of British industry The Report of the Association for the year 1928–29 contains a complete survey of its activities. The effects of selection, breeding, nutrition, climate, and pasturage on particular breeds of sheep, and the consequent effects upon the wool produced, are being investigated, with the financial assistance of the Empire Marketing Board, in conjunction with the Dominions overseas Physical and chemical problems continue to provide an extensive field of investigation. Much of this work has already been described in previous reports by the Association. The joint research with the Society of Dyers and Colourists upon fastness of dyestuffs and fading of fabrics due to light, perspiration, and other agents, is being continued

THE extent and complexity of the purely scientific problems which confront the textile industry at the present time are clearly described in the Report referred to above, and the difficulty of the dissemination of the results of the purely scientific work of the Association in the industry itself has received timely emphasis. The better utilisation of research, not merely in the textile industry, but also in British industry generally, is probably one of the most urgent needs of the present time. The final Report of Sir Arthur Balfour's Committee on Industry and Trade sounds a warning note upon this point when it states that before British industries, taken as a whole, can hope to reap from scientific research the full advantage which it appears to yield to some of their most formidable trade rivals, nothing less than a revolution is needed in their general outlook on science , and in the case of some industries at least this change of attitude is bound to be slow and difficult, in view of old and deeply rooted industrial traditions. The work of the research associations generally will be immensely facilitated if this view gains a wider appreciation amongst all those engaged in industry to-day.

IN his Friday evening discourse, delivered on April 19 at the Royal Institution, Prof. O T Jones described a visit to the Grand Canyon, Yellowstone National Park, last summer. This is the largest of the national parks in the United States, and is chiefly remarkable for its geological and physiographical features Volcanic accumulations of the Tertiary period make up a large area of the Park and attain a thickness of many thousands of feet The large number of existing geysers and hot springs indicates that the volcanic phenomena are not yet quite extinct. Among the most striking of the physiographic features of the area is the great canyon carved by the Yellowstone River on its way from the Yellowstone Lake to join the Missouri Physiographers have usually regarded the Grand Canyon as a product of erosion since the glacial period. An examination of sediments in the wall of the Canyon near the Great Fall has shown that they are sands, muds, and conglomerates extending in different places from the rim of the Canyon nearly to the bottom These prove beyond doubt that the Canyon since its excavation has been dammed at some point below, and in the lakes resulting from this process the sediments have accumulated, filling the Canyon to the brim. Further investigations have established that the Canyon since its excavation has been dammed by great flows of lava which entered the Canyon from the north and flowed against the drainage of the Yellowstone and its main tributary, the Lamar River A consideration of the profiles of the drainage system shows that prior to the damming episode the Canyon had been eroded in three or four stages or cycles of erosion , each new stage being initiated by uplift of the region. The lava flows entered the Canyon while the last cycle of erosion was in progress The results of these discoveries have thrown an entirely new light on the volcanic history of the Park, which will have to be examined anew.

THE Society for Experimental Biology met at the University of Manchester on April 19 and 20, the meetings being held in the Physiology Department through the kindness of Prof. H S. Raper Among the numerous contributions were an account of the growth and development of different types of bulbs by Prof F E. Weiss, and a stimulating discussion which followed the statement, by Prof D. Thoday, of the principles underlying the causal interpretation of plant anatomy Mr. M. A. H. Tincker described the effect of varying the daily light duration upon the time of flowering, form, and chemical composition of plants, while Mr E J. Collins outlined some experiments on the ' breaking ' of tulips Prof. H S. Raper gave an account of melanin formation among animals, pointing out that a similar mechanism appears to underlie all the cases explored, with possible exceptions among vertebrates. Mr. J. Needham discussed the evolution of the egg and the metabolic limitations which it imposed upon the embryo. Prof. T H Pear described his work upon the transfer of training in the acquisition of manual dexterity Mr. A D. Ritchie introduced an interesting discussion on the acid-base equilibrium in muscle.

THE Prime Minister of the Commonwealth has appointed a committee to take charge of the general arrangements for the proposed Australian Antarctic Expedition under Sir Douglas Mawson. Sir George Pearce, vice-president of the Executive Council, is chairman of the committee, and the other members are Sir Douglas Mawson (or, in his absence, Capt J. K. Davis, who will be second-in-command of the expedition), Sir David Masson, Rear-Admiral W R. Napier, Dr. A C D. Rivett, and Dr W Henderson. The expedition will undertake a coastal survey of the Antarctic continent south of Australia between longitudes 160° and 45° east, the *Discovery* having been placed at its disposal by the British Government.

It is anticipated that the ship's complement will number twenty-six, and that the scientific staff, including a press correspondent, will be twelve The starting-point of the expedition has not yet been determined, but operations will probably begin late in November and continue until the end of April 1930 It is very probable that a second season will be necessary to enable the whole programme of the survey to be carried through.

In the article on Christian Huygens in our issue of April 13, p. 575, reference was made to the object glass of 122 feet focal length which, according to Weld, was given to the Royal Society by Huygens in 1691. Weld also states that two other object glasses of Huygens' were afterwards presented to the Society by Sir Isaac Newton and the Rev. Gilbert Burnet From Prof. R A Sampson, Astronomer Royal for Scotland, we learn that the real donor of the first and the maker of all three lenses was Christian's elder brother, Constantine Huygens (1596–1687), and that, collaborating with Prof A E Conrady, Prof. Sampson has recently communicated to the Royal Society a paper containing a critical account of these historical lenses Weld's "History of the Royal Society" was published in 1848, but the mistake about the lenses had been pointed out by Uylenbroek ten years before. From the *Times* of April 22, we learn that the tercentenary of the birth of Huygens was celebrated the previous week at Leyden, the commemoration being organised by the Royal Academy of Sciences in conjunction with the University of Leyden and various scientific associations A souvenir account of the proceedings is to be published at Amsterdam

The issue of *Vox* for Mar. 1, edited by Prof. Calzia, of the University of Hamburg, contains an official communication of the International Society of Experimental Phonetics giving an account of the Conference to be held on July 24–31 next in Hamburg, with a list of addresses and demonstrations and an announcement that opportunities will be given for practical training in the methods of the science. The published list of members includes experimental phoneticians from nearly every country in Europe and also from America and Asia An account of a new and very practical form of stroboscope for observing the vocal cords is illustrated in detail. *Vox* is the official organ of the Phonetic Laboratory of the University of Hamburg, the Phonetic Institute of the University of Vienna, and the International Society of Experimental Phonetics. It is sent without charge to members of the International Society.

Dr. Millais Culpin has contributed an article on noise and hearing, considered from the psychological point of view, to a recent issue of *The Nineteenth Century* (vol. 105, No. 626). Few of those who most volubly protest against the noises of modern life are content to base their objection on the simple fact that unnecessary noise is irritating to most people, and that certain temperaments may find that irritation harmful to health. Instead, a pseudo-scientific terminology is used to describe fantastic happenings to the central nervous system. Dr. Culpin discusses the problem of nervousness, the relation of the nervous temperament to the degree of suffering from noise, the bewildering array of personal peculiarities that confronts any investigator of noise, the domain of the physiological injury when such can be proved to exist. The frequently urged view that energy is used up in ignoring noise, sounds plausible, but as it can neither be proved nor disproved it leads nowhere; arguing by analogy, however, there seems no reason to suppose that lack of attention to certain auditory sensations can be of any more danger to the organism than lack of attention to any other sensory stimulation. The article is a very timely and necessary corrective to the loose thinking and over-simplification characteristic of many writers on the subject Dr. Culpin also makes the subject much more valuable by treating it in relation to other problems and not as an isolated phenomenon.

An authoritative committee, composed principally of veterinary surgeons in charge of slaughter-houses, recently held at Leeds a trial of the Weinberg casting pen, the object of which is to ensure that no suffering shall be inflicted when beasts are cast for slaughter by the Jewish method (shechita). It is therefore satisfactory to know that the report of the committee is entirely favourable The chairman was Prof F. T. G. Hobday, principal of the Royal Veterinary College, and the honorary secretary Capt. C. W. Hume, of the University of London Animal Welfare Society. The members included Prof. Lovatt Evans, five veterinary surgeons in charge of large abattoirs, and two representatives of animal protection societies. It is understood that two further machines having the same object are to be tried out in the near future. The subject is one upon which feeling runs very high in some slaughter-houses, and in these circumstances it is not easy to ensure the scientific character of the trials by eliminating incalculable human factors. The committee will doubtless, however, be fully alive to this consideration.

In a recent address to the Institution of Electrical Engineers, Mr J. Swinburne gave an account of Sir Joseph Swan's inventions in connexion with the carbon filament electric lamp. In the April *Journal* of the I E E, Mr. A. Campbell Swinton has a note on the part played by Lane Fox Pitt in the invention of this lamp He thinks that neither Mr Swinburne nor Sir Ambrose Fleming in his 'personal recollections,' published in the February issue of the *Journal*, do justice to this inventor, and points out that he was the first patentee of the method of 'flashing' used in making carbon lamps, and was the inventor of the constant voltage system of public lighting with the lamps in parallel. In the same journal Mr. Swinburne replies that he does not know who invented the method of 'flashing.' In his address he was discussing Swan's work, and as Swan got no help from Lane Fox Pitt's work, it was unnecessary to discuss the work of the latter. He mentioned, however, in his address that Pitt did take out a patent on parallel distribution a year before Edison, which, although bad

in law, propounded with luminous clearness parallel distribution, and dispelled for ever the fog about 'the subdivision of the electric light'

AT a meeting held in the Natural History Theatre of the University of Manchester on Feb 23, a provisional committee was appointed to draw up a scheme for co-ordinating the work of the scientific societies, especially those following biological lines of research, in north-western England and Wales The committee has now issued a circular with suggestions for the establishment of a "North-Western Naturalists' Union," which will, it is hoped, be definitely inaugurated in June Membership of the Union will be open to individuals as well as to societies in the area proposed, which includes the English counties from Cumberland to Staffordshire and Shropshire, North Wales, and the Isle of Man It is believed that such a Union may be of great service to the local societies, by holding a yearly general meeting and conference, by arranging exchanges of lecturers between the various centres, and by facilitating the publication of papers. For many years past there has been at work a strong naturalists' union in north-east Lancashire, and it is hoped that the more comprehensive union now proposed will be a means of help and encouragement to the large number of earnest Nature-lovers who pursue their studies in the busy industrial towns and the countryside of the north-west of England

THE Australian National Research Council has elected Sir Thomas Lyle, formerly professor of natural philosophy in the University of Melbourne, to the office of president in succession to the late Mr R. H. Cambage.

AT the meeting of the London Mathematical Society on Thursday, May 16, at 5 P.M at Burlington House, Prof. C. G Darwin, of Edinburgh, will deliver a lecture on "The Refraction and Scattering of Light." Members of other scientific societies who may be interested are invited to attend

SIR OLIVER LODGE is to deliver the nineteenth annual May Lecture before the Institute of Metals on Tuesday, May 7 The title of the lecture will be "Some Ideas about Metals" Cards of invitation to the lecture can be obtained by sending a stamped and addressed envelope to the secretary of the Institute of Metals, 36 Victoria Street, London, S W 1.

IT is announced in *Science* that Prof. Frank Schlesinger, director of the Yale University Observatory, has been awarded the Bruce Medal of the Astronomical Society of the Pacific for his work on photographic parallaxes and in other departments of astronomy The medal is awarded on the recommendation of the directors of the Harvard Observatory, Lick Observatory, Yerkes Observatory, the Observatory of Berlin, the Observatory of Greenwich, and the Observatory of Paris

THE Council of the Institution of Automobile Engineers has awarded the medal of the Institution to Capt J S. Irving in appreciation of his brilliant work in connexion with the design of the "Golden Arrow," which, coupled with the courage and skill of Major Segrave, has resulted in the world's speed record being once more held by Britain, and this time by a very large margin The medal was established in 1922 as a recognition of technical achievement likely to have special influence on the advancement of automobile engineering

THE annual congress of the South-Eastern Union of Scientific Societies will be held at the Royal Pavilion, Brighton, from Wednesday, June 5, until Saturday, June 8, inclusive, by invitation of the Brighton and Hove Natural History and Philosophical Society, and the Worshipful the Mayor and Corporation of Brighton. Sir Arthur Keith has consented to serve as president in succession to Sir Martin Conway. The honorary general secretary of the Congress is Mr E A. Martin, 10 Avenue Road, South Norwood, S.E 25, and the assistant hon. secretary is Mr. R W. Strickland, 5/6 Clements Inn, W C 2

WE learn from a *Daily Science News Bulletin* (Science Service, Washington, D C.) that the United States Senate has passed a bill providing pensions of 125 dollars per month for the Army officers and enlisted men, or their widows or heirs, who took part in 1900 in the yellow fever investigations carried out in Cuba under Major Walter Reed, which demonstrated conclusively that yellow fever is not infectious or contagious in the ordinary sense. Further, the names of the 22 men (of whom 14 survive) of the expedition are to be published annually in the Army Register as a roll of honour, and each of the men or their heirs is to be presented with a commemorative gold medal.

AT the annual general meeting of the Physical Society of London, held on Mar. 22, the following officers were elected :—*President* Dr. W H Eccles ; *Vice-Presidents* . Sir Oliver J. Lodge, Sir Richard Glazebrook, Prof H. L Callendar, Sir Arthur Schuster, Sir J. J. Thomson, Prof. C. Vernon Boys, Prof C. H. Lees, Sir William Bragg, Dr. Alexander Russell, Dr. F E. Smith, Prof. O W. Richardson, Mr R. W. Paul, Dr. J. S. G. Thomas, Prof. A. O. Rankine, and Prof. F. L. Hopwood ; *Hon. Secretaries* Dr. Ezer Griffiths and Dr. Allan Ferguson , *Foreign Secretary* Prof. O. W. Richardson ; *Hon Treasurer* · Mr. R. S. Whipple ; *Librarian* Mr J. H Brinkworth.

A PRIZE consisting of a medal and the sum of £500 is offered by the British Empire Cancer Campaign to the person, or group of persons, who shall submit the essay embodying the results of original investigations which, in the opinion of the judges, is the best contribution towards the early diagnosis of cancer. The competition is open to British subjects of either sex, resident in the British Empire or the Dominions, who can obtain a copy of the rules and regulations relating to the prize by writing to the secretary of the British Empire Cancer Campaign, 19 Berkeley Street, W.1. The latest date for the receipt of essays is Dec. 31, 1931. The award will be made early in the following year.

AN interesting article by Prof. Luigi Devoto on the results which have followed the institution of 'summer

time' appears in the *Rendiconti* of the Royal Lombardy Scientific and Literary Institute for last year This question was discussed at the seventh Italian National Congress of Industrial Medicine, held at Parma, following a paper by Prof Gaetano Pieraccini, who considered more particularly its hygienic aspects. Pieraccini's conclusions, given *in extenso*, indicate whole-hearted accord with daylight-saving, which has resulted in the checking of various maladies favoured either by lack of light or by the use of artificial illumination.

A CATALOGUE (No 8) of miscellaneous second-hand books of science, mainly of botanical and zoological interest, has been received from Mr J H Knowles, 92 Solon Road, S W 2

READERS interested in West Africa may like to have their attention directed to a short catalogue of second-hand books relating to that part of the world which has recently been issued by Messrs Francis Edwards, Ltd., 83 High Street, Marylebone, W 1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A senior curator of the Museum of St Bartholomew's Medical College—The Dean of the Medical College, St Bartholomew's Hospital, E C.1 (April 29). A research studentship at St. Mary's Hospital Institute of Pathology and Research—The Secretary, Institute of Pathology and Research, St. Mary's Hospital, Paddington, W 2 (April 30) A lecturer in engineering, with special qualifications on the electrical side, at the Plymouth and Devonport Technical College—The Secretary for Education, Rowe Street, Plymouth (May 4). A junior scientific officer in the Admiralty Scientific Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W 1 (May 4). A lecturer in engineering at the Widnes Municipal Technical College—The Clerk to the Governors, Town Hall, Widnes (May 6) A male assistant at the Low Temperature Research Station, Cambridge—The Superintendent, Low Temperature Research Station, Cambridge (May 6) An inspector of weights and measures under the Surrey County Council—The Clerk of the Surrey County Council, Public Control Department, County Hall, Kingston-upon-Thames (May 6) A first assistant in the Clinical Laboratory of the Manchester Royal Infirmary—The Gen. Supt and Secretary, Royal Infirmary, Manchester (May 8) A pathologist and bacteriologist at the Northern Infirmary, Inverness—The Hon. Secretary, Northern Infirmary, Inverness (May 8) The Anderson lectureship in comparative psychology in the University of Aberdeen—The Secretary, University, Aberdeen (May 28). A professor of anatomy at St Bartholomew's Hospital Medical College—The Academic Registrar, University of London, S W.7 (May 30). A professor of mathematics at Canterbury College, New Zealand—The High Commissioner for New Zealand, 415 Strand, W.C 2 (July 31) A junior assistant under the Directorate of Metallurgical Research, Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S E.18 A senior biology master at the Cambridge and County High School for Boys—The Education Secretary, County Hall, Cambridge A full-time teacher of electrical engineering at the Barnsley Mining and Technical College—The Principal, Harvey Institute, Barnsley A woman biochemist at the Wellcome Physiological Research Laboratories—The Director, Wellcome Physiological Research Laboratories, Beckenham.

Our Astronomical Column.

HALLEY'S COMET AND THE AQUARID METEORS OF MAY 2–6 —One of the greatest of English astronomers was Edmund Halley, who acted as Astronomer Royal about two and a half centuries ago Amongst the most important of his achievements was the discovery that a bright comet, visible in 1682 and first seen by an assistant of Flamsteed, revolved around the sun in about 76 years and had been observed in the years 1531 and 1607. He predicted its return in 1759, and this was realised

Since Halley's day, further investigations have elicited the fact that the comet has been in existence and visiting the sun during more than 2000 years It was last observed in 1910, and will probably reappear in about 1986. One of the occasions on which it returned was the momentous year 1066. Certain disasters and historical events were formerly connected by superstitious people with its visits.

This remarkable object is the largest of all the periodical comets, and it is notable as being the source of a meteoric display which occurs during the first week in May. Capt. Tupman discovered it about sixty years ago, and it has been reobserved on many occasions since, though it has never furnished a really great abundance of meteors. But the objects derived from this comet are unequalled in splendour and length of flight by any other meteoric display in the heavens. The earth and comet do not encounter each other centrally, for their orbits at the points of nearest approach are separated by several millions of miles of space. The meteors, therefore, which the earth encounters are only those placed on the outer fringe or outskirts of the system Some of the large fireballs belonging to it may possibly be observed in the morning twilight of May 2–6 next, between about 1 A M and 3 A M The conditions prevent their apparition during the earlier hours of the night.

QUANTITATIVE ANALYSIS OF THE SUN —Prof H. N. Russell contributes an interesting article on this subject to the *Scientific American* for April. He gives a sketch of various stages in the history of spectroscopy. The earliest stage lay in the simple recognition of the presence of various elements in the sun and stars. Then followed the stages of the study of radial velocities, and of the detection of magnetic fields Attention is now being given to the contours of lines—curves indicating the gradations of intensity throughout their widths and deductions as to the density with which the atoms are packed in the course of the ray of light. It is stated that the weakest lines on ordinary stellar spectrograms (of intensity 1 on Rowland's scale) could be produced by 2×10^{13} atoms per square centimetre, which is a millionth of the number in a cubic centimetre of air, further, that the whole amount of gas in the sun's atmosphere, if condensed to the density of our air, would form a layer between 10 centimetres and 1 metre in thickness.

Research Items.

LOVELOCK CAVE.—In 1911, during mining operations for bat guano, numerous ancient Indian objects were discovered in the Lovelock Cave in the Humboldt Valley of West Central Nevada. Further excavations were carried out under more favourable conditions in 1924 by Mr. M. R. Harrington and Mr. Loud, which are now described in a fully illustrated monograph issued as No. 1 of Vol. 25 of the *University of California Publications in American Archæology and Ethnology*. To the description of the recent excavations Mr. Loud adds an account of the objects obtained in 1912. Originally Lovelock Cave was a long shed-like rock shelter about 150 feet in length and 35 feet wide. Earthquakes and other natural agencies caused masses of rock to fall from the roof blocking the opening in front, converting it into a cave. The local Indians, the Northern Paiute, have a legend that the inhabitants were Pit River Indians whom they drove out. The cave had undoubtedly been used as a dwelling-place, and not solely as a cemetery and place of ceremonial deposit, as has been suggested. The earliest horizon of occupation belongs to the Basket-Makers of possibly three to four thousand years ago, with possibly sixty burials in the cave, and as the cave refuse lies directly on the lacustrine deposits it begins possibly within a hundred years of the subsidence of Lake Lahontan. The deposits of human origin show no bones of the sabre-tooth tigers, horses, or camels found in the lake-shore gravels. The culture of the earliest occupation resembles, but is poorer than, that of the Basket-Makers, nor was there any knowledge of agriculture. It resembles the hypothetical 'basic culture' of the south-west. After a deposit of five feet, a foreign influence creeps in, forming a transition period, and finally, as it grows stronger, the bow and arrow appear. Then begins a 'Later Period,' possibly about A.D. 1000, containing many articles which have their counterpart among the modern Paiute. The cave dwellers would thus appear the cultural, if possibly not the linguistic, kinsfolk of the Northern Paiute.

THE AUSTRALIAN ABORIGINAL BRAIN.—Prof. Woollard (*Jour. Anat.*, vol. 63, pt. 2, pp. 207-223) gives an account of four brains of aboriginal Australians. He finds that the aboriginal Australian brain is a small brain, extremely dolichocephalic, in which the insula tends to be exposed and the primitive features in the organisation of the striate area to be retained. His observations offer no ground for supposing that the aboriginal brain discloses any peculiar simian features or that it resembles microcephalic brains of European origin, or that it retains any special features of the fœtal human brain. He finds that the variations in the indices of the aboriginal brain present no peculiar features, and the differences between it and the European brain are adequately accounted for by the extreme dolichocephaly. The proportion of grey to white matter in the hemispheres is the same as in the European brain, and there are no significant differences between the right and left hemispheres. The total weight of the brain and the weights of the hemispheres are smaller than in the European brain.

NERVOUS SYMPTOMS AND VOCATIONAL SELECTION.—In the *Revue de la Science du Travail* (Tome I., No. 1), Dr. Toulouse directs the attention of students of vocational selection to the problem of the nervous person in the industrial world. He maintains that slight nervous troubles are infinitely more common than any one is aware of, and that their action on the output of the worker is disastrous. He contrasts the limited and ascertainable effect on output of an organic disease, with the irregular and incalculable effect of nervous symptoms. There is here no question of the intelligence, which might be of the highest order, but of an emotional or temperamental instability, over which the person has little control, leading to erratic work curves and long sickness absenteeism. He pleads for a greater recognition of this factor by those doing mental testing and for a periodic examination of employés during their industrial career. The nervous condition which in the typist may involve an unusual number of errors may in a signalman lead to a disaster. It is probable that behind an accident is an emotional instability and not a defective sense organ or intellectual weakness. A similar conclusion was reached by the Industrial Fatigue Research Board after an investigation of telegraphist's cramp: it was shown that those who suffered from that disorder, which essentially involved even in the earlier stages a diminished output, were of the temperament popularly called 'nervous'.

SEA-TROUT IN SCOTTISH WATERS.—In his paper "Sea-trout of the River Ailort and Loch Eilt, Part 2, 1920 and 1925–27. With an Appendix on Ailort Salmon" (Fishery Board for Scotland: Salmon Fisheries, 1928, No. 9), Mr. G. Herbert Nall continues his work based on scale reading, the first part of which was published in 1926. The present part embodies the results obtained by analysing both the old and the new material, a résumé being made of the whole. The sea-trout of this district, like most of those of the west-coast rivers, have a more uniform type of life than those of the east-coast rivers, the chief features in the river Ailort being the big runs, beginning as early as March and mainly composed of fish which have spawned in the previous winter, and the high average size of the fish, a few of which attain a great weight. The size is mainly due to good feeding and favourable conditions both for the parr and the sea-fish, giving rise to a vigorous stock. The Ailort fish survive to a greater age and weigh more than do those of the east-coast rivers, and maturity is reached rather later. Early spawners seldom survive the tenth year from hatching, whilst amongst those which spawned later in life some exceed fourteen years, and the percentage of survivors rises with the increase in the number of sea years before maturity is attained. Spawning retards growth, but to a less degree than in the salmon. Salmon smolts usually migrate after two years of river life, those of the sea-trout after three years. Salmon smolts at migration are about two inches shorter than those of the salmon-trout of the same age. During this river life the salmon parr grow more slowly than those of the sea-trout, but after migration the growth-rate of the salmon is by far the larger. It has often been suggested that some of these large Ailort sea-trout are hybrids between salmon and sea-trout, but although experiment has proved that salmon eggs can be fertilised by sea-trout milt and vice versa, the author is of the opinion that there is no indication of hybridisation between salmon and sea-trout, nor are there two or more distinct races of the latter in the Ailort.

PARASITES AND PREDATORS IN BIOLOGICAL CONTROL OF INSECT PESTS.—In the *Bulletin of Entomological Research*, vol. 19, March 1929, Dr. W. R. Thompson discusses this important subject. As he points out, both predaceous and parasitic insects practically always kill their hosts. The question of their relative

value as controlling factors is, however, somewhat obscure That insect predators are numerous and beneficial is generally acknowledged, but that they are as valuable in these respects as parasites is not by any means universally believed. This subject is ably discussed by Dr Thompson, who advances theoretical conclusions, partly based upon calculations of the length of time necessary for the annihilation of a given host population by given populations of gregarious parasites, solitary parasites, and predators His theoretical conclusions indicate that the value of predators has been underestimated by practical entomologists, and they are supported by the history of the practical application of biological control As examples, he quotes the efficiency of such predators as Coccinellidæ in controlling certain scale insects and mealy bugs the utilisation of the carabid beetle *Calosoma* in controlling the gipsy moth in New England and the extraordinarily valuable results attained by the introduction of the capsid, *Cyrtorhinus mundulus*, in controlling the sugar-cane leafhopper in the Hawaiian Islands He concludes that predators are worthy of more careful attention than has so far been accorded them, but that the relative values of parasites versus predators in any given case can only be decided by critical investigation in the field.

Pre-Cambrian Life —Some months ago it was announced in the daily Press that a pre-Cambrian fauna had been discovered in South Australia. Some details of this have now been given by Sir T. W. Edgeworth David in "Notes on newly discovered fossils in the Adelaide Series (Lipalian ?), South Australia" (*Trans. Roy. Soc S Australia*, 52, pp 191-209, pls xiii-xviii , 1928). He considers that he has found the remains of Algæ, polychætous annelids, brachiopods, and eurypterids in the Adelaide Series at horizons ranging from 2000 to 12,000 feet below the oldest rocks in which undoubted Lower Cambrian fossils have been traced. The age may be (1) basal Lower Cambrian *or* (2) Lipalian, that is, belonging to the time represented in North America by the unconformity between the Keeweenawan and the base of the Cambrian, *or* (3) Proterozoic (Algonkian). Without seeing the specimens on which Sir Edgeworth David's views are based, it is almost impossible to express an opinion as to their nature. The figures which he gives are not convincing. If he has really found eurypterids in beds of pre-Cambrian age, it is difficult to account for the fact that scarcely any undoubted representatives of that group of arthropods have been discovered in the Cambrian.

Tropical Agriculture.—The Imperial College of Tropical Agriculture, Trinidad, has issued its report for 1927–1928 together with the prospectus for 1929–1930. Developments have been made in all directions, and further extensions are hoped for in the near future. An estate is specially needed for research, principally into biological problems, as the existing grounds are required for the instruction and training of students. The power station is now in use and the new building for low temperature research and cold storage is completed, although the interior fittings of the latter are not yet finished The construction of a new chemical block is proceeding, and alterations and additions have been made in the sugar factory. In research work good progress has been made. With regard to bananas, the main objects are to secure good marketable varieties immune from Panama disease (a problem which necessitates a study from both the pathological and phsyiological point of view), and further to investigate the ripening process in order that the fruit may be successfully marketed overseas. The new cold storage chamber will prove of special benefit in these problems. Soil research with reference to the sugar-cane crop has been successfully carried out. The lime content of the soil, and particularly the proportion of adsorbed calcium ions, has been shown to be correlated with the resistance of the plant to froghopper blight. A practical outcome of this work is that the College is now able to advise growers as to the amount and kind of lime to apply to their fields, and the methods of application to employ. On the other hand, insecticide work has also proved successful, and the froghopper pest can now be kept under control if the proper executive arrangements are made at the right time, the cane growers acting collectively. The main objects of research in the coming year are problems dealing with tropical fruits such as bananas and citrus, biological investigations of cacao, and genetical and fertiliser trials with sugar-cane

Iso-electric Point of Cells and Tissues.—In a recent number of *Biological Reviews* (4, p. 1) H. Pfeiffer has contributed a comprehensive review of the now voluminous literature bearing on this subject, in which he points out that the original conceptions of the iso-electric point (IEP) are tending to develop both in physical chemistry and in biology Cells and tissues of plants, and perhaps of animals, show many analogies with ampholytes, probably owing to the presence of these substances at the cell surfaces, and at the internal boundaries of the protoplasm. From the observed effects, attempts have been made to determine the IEP in the case of a given tissue, and also to explain the regulatory effects of the cells upon external solutions Pfeiffer points out that most biological work has been concerned not with the *true* IEP, which is given by the stationary phase in electro-cataphoresis, but with the *apparent* IEP (as found, for example, from minima of swelling, viscosity, and osmotic pressure), which depends primarily on the reaction at which there is a maximum of neutral molecules. The apparent IEP determined in this way may be displaced owing to salt formation, and this is particularly likely to happen in the case of protoplasmic ampholytes. Further, the presence of two or more ampholytes in protoplasm does not, on present conceptions, necessarily lead to the establishment of a collective IEP as it may tend to do *in vitro*. There may, in cases known, be signs of a number of apparent iso-electric points. The relation of the apparent IEP to growth and physiological functions of the organism is discussed, and the author emphasises the view that further work is required on the effect of these phenomena on ion movement and the electro-histological behaviour of protoplasm, and on the mechanism of such functions as protoplasmic streaming

Cyclones at Mauritius.—Mr. R. A. Watson, Director of the Royal Alfred Observatory, Mauritius, is to be congratulated for producing "The Cyclone Season 1927–8 at Mauritius," which is to be the first of an annual series of publications summarising the information collected at that Observatory about the cyclones occurring in the neighbourhood during each cyclone season. The cyclone season in Mauritius extends normally from November to May ; the one under discussion was one of the stormiest on record, and was remarkable also for the fact that the tracks were farther west than usual, to which peculiarity the absence of gales at Mauritius itself is to be referred The weather reports from neighbouring islands were supplemented by information supplied by ships calling at the island In two instances enough observations were available to allow of the construction of diagrammatic systems of wind arrows in which the wind represented is the wind relative to the moving centre, the isobars being shown in the usual way. It is interesting to

find some evidence of a discontinuity of wind along the actual track in front of the centre, and not, as was found by Cline in the case of West Indian hurricanes (NATURE, Dec. 24, 1927, p. 909), between the winds of the two quadrants on one side of the track. Allowing for the reversal of the circulation as between storms of the northern and southern hemispheres, the analogue for Mauritius of the 'right rear' and 'right front' quadrants, between which the discontinuity was found by Cline, would be the 'left rear' and 'left front' quadrants. These diagrams are of interest also in that they show some flattening of the isobars in a direction parallel with that of the track, and constitute additional evidence of a lack of that symmetry of wind circulation usually attributed to the tropical cyclone in meteorological text-books.

THE AURORA.—The investigation of conditions in the upper air which has been made by E. O. Hulburt and H. B. Maris in connexion with their theory of the aurora and of magnetic storms (*Physical Review*, vol. 33, pp. 412-431, see also NATURE, Nov. 24, 1928, p. 807) is remarkable for the importance which is attached to the influence of the ultra-violet radiation from the sun. The wave-lengths which are absorbed at heights above about 450 kilometres are supposed to produce indirectly, by processes of excitation and ionisation, a kind of spray of highly rarefied matter which extends outwards for upwards of forty thousand kilometres. Collisions are very infrequent at the low pressures involved, and the molecules can describe practically free orbits in the earth's gravitational field. If one is ionised by further absorption of ultra-violet light, both the liberated electron and the residual positive ion will return to the lower air in helical paths, the axes of which are determined by the earth's magnetic lines. The aurora is associated with the downward currents, and its distribution over the surface of the earth can be predicted immediately from the magnetic field of the latter. This theory, which has been developed on quantitative lines, seems to account adequately for the main phenomena both of auroræ and of the complicated changes which occur in the magnetic elements during a magnetic storm, and the greatest difficulty in its further development is likely to arise from incomplete knowledge of the precise nature of the atomic processes of excitation and ionisation. The authors mention incidentally that good direct short-wave communication was maintained between the U.S. Naval Research Laboratory at Washington and the Byrd Antarctic expedition.

EFFECT OF HEAT ON THE SENSITIVITY OF PHOTOGRAPHIC PLATES.—The results of an investigation of the effect of heat on the sensitivity of photographic plates are described in two papers by O. Masaki in the *Memoirs of the College of Science, Kyoto*, Series A, vol. 12, No. 1. It was found that the sensitivity of panchromatic and other slow emulsion plates increased with rise of temperature, the sensitisation being greatest towards the red part of the spectrum. In the case of high-speed plates, rise of temperature produced a decrease in sensitivity, especially in the violet region. For all kinds of plates, heating increased the contrast, and in panchromatic and orthochromatic plates this change was particularly marked for rays of long wave-lengths. The sensitising action of heat was retained for some hours after the temperature had been reduced to normal and was much greater than that produced by mere drying of the plates. An expression giving the relation between the density of the developed image and temperature was obtained and holds from 10° C. to 80° C.

FLAME- AND SPARK-SPECTRA FROM SALT SOLUTIONS.—In the *Chemiker-Zeitung* of Mar. 16, Dr. W. Hirschel describes some quantitative results which he has obtained with the apparatus first described by him in 1916, in which minute amounts of salt solutions are pulverised by means of a spark before being introduced into the Bunsen flame. The resulting flame can be maintained for an hour with the consumption of only a few milligrams of salt, and the flame is so intense that its spectrum can easily be photographed. The apparatus has hitherto been used for the visual examination of spark spectra, but it has now been found possible to photograph the latter. This has necessitated the use of much stronger sparks than were possible in the original apparatus. A device for cooling the anode with cold water has been introduced, and instead of a large induction coil and battery of cells, a simple Wehnelt-Simon-Caldwell interrupter is used with an alternating current at 115-220 volts and a small coil.

ATOMIC WEIGHT OF COPPER.—A communication by T. W. Richards and A. W. Phillips in the February number of the *Journal of the American Chemical Society* describes experiments on the atomic weight of copper from different sources. No difference was found in the atomic weights of specimens of copper from mines in the Lake Superior region and from Chile. The ratio of the atomic weights of copper and silver was found by analysis of pure cupric chloride. On the basis of $Ag = 107 \cdot 880$ the atomic weight of copper was found to be 63.557. Copper is known to have at least two isotopes and its atomic weight was in need of confirmation. The Lake Superior material was not later than Cambrian, that from Chile was from lodes intrusive in Jurassic strata.

SIZE LIMITS OF TURBO-GENERATORS.—During the last few years there has been a remarkable increase in the size of the turbo-generators used in electric power stations. The size of the machines which run at 25 revolutions per second is now only limited by the transport facilities available to their destination. The desirable size of the machines which run at the standard speed of 50 revolutions per second is about 60,000 kilovolt-amperes at the present time, but in a few years machines of double this capacity will probably be running. The uncertain factors are the strength of the forgings forming the rotating part and whether the journals for such heavy machines would be safe. The centrifugal forces and the consequent enormous stresses in the rotating parts at these high speeds make it necessary to use only forgings of the greatest mechanical strength. In a paper read by J. A. Kuyser to the Institution of Electrical Engineers on Mar. 21, it was stated that a steel containing about 2 per cent nickel with a very small percentage of chromium, when properly annealed, has the necessary tensile strength. On the Continent the alloy used for high-speed machines has a much larger percentage of nickel and chromium, and is hardened in oil. However, experiments carried out by Metropolitan Vickers led to the conclusion that the oil hardening of this steel produces a high radial stress which when the machine is running is added to the centrifugal stress. A significant fact is that on the Continent during the last three years there have been four explosions, with several fatalities, of high-speed machinery made of this steel. It was stated that several of the older types of machines are operating with parts of their core at 200° C. These high temperatures cause relative displacements of the copper and the mica insulation, as the temperature coefficient of copper is 50 per cent greater than that of mica.

Mimicry.

By Dr G D HALE CARPENTER, Entebbe, Uganda

THE phenomena of mimicry, by which is meant the deceptive resemblance of one creature to another, were first made known among butterflies, and it is natural that the subject should have been further investigated in the same group of insects But it has suffered thereby, for the narrowing of the field of inquiry has resulted in attempts to account for the phenomena which do not bear criticism in the light of wider knowledge and more detailed investigations into geographical distribution

Mimetic resemblances are undoubtedly most convincingly explained as the result of the operation of natural selection upon such variations as may be produced from time to time We may in this connexion quote the words in which Darwin, writing to Ara Gray, expressed his confidence in natural selection as the motive cause of evolution. "I cannot possibly believe that a false theory would explain so many classes of facts as I think it certainly does explain On these grounds I drop my anchor, and believe that the difficulties will slowly disappear"

Since H. W Bates first published his memoir on mimicry in 1862 an immense number of field observations have been recorded and a large amount of work has been expended upon museum specimens, but the theory of natural selection still offers the most convincing explanation of the facts

Attempts have been made to account for mimetic resemblances by the similar results produced by climatic or other external influences upon different species in the same locality, and such an explanation is given by Prof E W MacBride in his essay on "Zoology," p. 211, in the collection of papers published in 1925 by Messrs. Blackie and Son under the the title of "Evolution in the Light of Modern Knowledge"

Prof MacBride observes: "We have given to our readers strong reasons for disbelieving altogether in random variations, and therefore what we have to explain is why evolution has set in such a direction as to cause these insects to resemble one another. Now, Eimer has shown that the changes in coloration which the mimic is supposed to have undergone, in order to increase its resemblance to the model, are of a kind which supervene independently in all families of butterflies and moths as *a reaction to climatic conditions* These changes take place in some families more quickly than in others, and what happens in real 'mimicry' is apparently that individuals which have reached a certain stage in this process are favoured by natural selection"

Mimetic resemblance is thus believed to have been caused by an inherited response to environmental influences. "Just as in the formation of habit the action becomes easier with every repetition, so as the generations succeed each other the response to the same environment becomes more readily called forth" Prof MacBride alludes later to "the vast sea of facts which tell in favour of habit as being the prime cause of evolution." He acknowledges the unsatisfactory nature of this as an explanation of mimicry; how unsatisfactory it is and how completely it fails to account for recently discovered facts it is the purpose of this article to show.

Let us first consider some examples from among the butterflies alone, as this explanation was founded on a study of their patterns.

1. The effects of intrusion of a foreign species upon the indigenous inhabitants.

(*a*) A very good example is that of the 'Monarch,' a Danaine butterfly belonging to an Asiatic group which invaded North America in comparatively recent times, and is there mimicked by an indigenous butterfly, the 'Viceroy,' closely related to our 'White Admirals' of Europe Clearly, if these resemblances are the result of local climates, the 'Monarch' ought to have mimicked the 'Viceroy'!

(*b*) Again, in the eastern Fijian islands a group of Euplœine butterflies is characterised by a dark ground-colour with a feeble or obsolete white marginal pattern, while the same species are represented in the western islands of the group by forms with a strongly marked pattern Prof E B Poulton has suggested that these facts are to be explained by an earlier invasion of Fiji by the dark Euplœas and a later powerful invasion by a strongly patterned *Euplœa*, which has reached the western islands in numbers and has become the model mimicked by the older darker species

2 The phenomena of mimicry, even among butterflies, cannot be disposed of so easily as Eimer's explanation suggests; they are much too complicated The study of geographical races is all-important in this connexion

(*a*) A typically aposematic or warningly coloured species of the Acræine genus *Planema* (*P. epœa*) has in West Africa a black and orange male and black and white female In the Uganda race *epœa paragea*, however, the sexual dimorphism disappears and the coloration of both male and female is grey-brown with a pattern of cream-colour Both these races are mimicked by the females of *Papilio cynorta*, which in West Africa resemble the black and white females of *epœa*, and in Uganda both sexes of *epœa paragea* The *Papilio* male retains the same appearance in both areas. On the other hand, a Nymphaline butterfly in Uganda, *Pseudacrœa eurytus*, allied to our 'White Admirals,' has developed a form *obscura* in which both sexes mimic *epœa paragea*. Climate, according to Eimer's hypothesis, has caused one sex of the *Papilio* to resemble the model but both sexes of the Nymphaline. This, however, is far from the end of the story. *Pseudacrœa eurytus* occurs all over tropical and subtropical Africa in a bewildering variety of forms, sometimes with sexes alike, as in the form *obscura*, sometimes unlike. Wherever these *Pseudacrœas* occur they are mimetic of the local species of *Planema*, sex resembling sex when the sexes of the model are unlike. But in Uganda some of the *Planema* models, such as *epœa paragea*, have the sexes alike, while in others they are different, and the local forms of *eurytus* mimic both types Hence in the same area, and therefore subject to the same climatic influence, most surprisingly complicated and contrasted results have been developed. It may be argued that equally complicated results have arisen among the models in the same area; but there is this essential difference—the Planemas are of entirely different species, whereas the mimetic forms of *eurytus* belong to a single species, so that mimics with sexes different and with sexes alike form a single interbreeding community and may appear side by side in a single family

(*b*) Equally difficult to explain by Eimer's theory are the intricate mimetic resemblances between members of the fine genus *Charaxes*. Some of the larger species which act as models for the smaller are themselves mimics of other large species, and one sex of a species may be a mimic while the other is a model. Yet another species (*etheocles*) has a non-

mimetic male which varies little, but the females occur in strikingly different forms which mimic the males, others the females, and others again both males and females of larger species

3 Explanations of mimicry are too often based on consideration of colour and pattern alone. Any naturalist familiar with mimetic resemblances in the field has found by practical experience that colour and pattern are only part of the factors which make up the deception; behaviour is of great importance. Even among butterflies themselves the difference of behaviour between models and some mimics is characteristic, if the mimic belongs to a family less well protected than the model. For example, the Acræine models of the genus *Planema* can often be picked from flowers by the fingers, while the mimetic forms of *Pseudacræa eurytus* are shy, and require to be approached with caution if they are to be caught. If frightened they dash away, whereas the *Planema* will only flutter just out of reach and often boldly return to the same spot

Even if it be admitted that the action of climatic conditions is effective in causing different species of insects to develop the same variations in coloration, it cannot be held to explain instances of mimicry drawn from a much wider field than that from which Eimer drew his examples. How could the likeness of certain spiders to ants be put down to this cause? Many instances have been recorded where the mimicry has completely deceived experienced field naturalists Climate in this case must be supposed to have altered profoundly the characteristic shape of spiders so as to produce the 'waisted' effect of an ant; to have altered gait in such a way that one pair of legs is not used for progression but is held up in the air and waved about to resemble the sensitive antennæ of an ant, and even, in certain spiders, to have suppressed, except in very special circumstances, the habit of jumping that is characteristic of the family to which most ant-like spiders belong.

Spiders, having no metamorphosis, are generally exposed to similar conditions at all stages of their existence Insects which undergo complete metamorphosis are exposed to conditions during their immature stages which often differ as completely as possible from those to which the adult stages are exposed. The close resemblances often found between adult insects cannot possibly be explained as due to the action of absolutely dissimilar conditions upon their respective larvæ For example, the mimetic resemblance of the common drone-fly to the hive-bee deceives even a monkey, as I have found by experiment in Africa The larva of the fly lives in mud and foul fluids among which it feeds in the open, freely exposed to changes of light, temperature, and oxygenation. The bee's grub is enclosed in a small cell in the hive, among surroundings as uniform as the bees can make them, feeding on food supremely different from that of the fly's larva. Malacoderm beetles of the family *Lycidæ* all over the tropics are mimicked extensively by insects of such diverse habits, and feeding in such different ways as larvæ and adults, that no explanation based on the influence of external circumstances can account for the well-known mimicry of these conspicuous beetles, which have been abundantly proved to be distasteful to birds and other animals

4. Mimics differ from their models not only in behaviour but also in other respects A typically aposematic insect such as an Acræine or Danaine butterfly, or a Lycid beetle, is of an extremely tough physique It will be uninjured by treatment which would break the wings of another butterfly such as the Nymphaline or Papilionine mimic, and it will also resist the poisonous fumes of a cyanide bottle to a surprising extent. This resistance to injury is part and parcel of the process whereby an aposematic insect teaches an enemy that it is harmful or unpalatable It almost invites attack, and if it is seized and handled, suffers little injury, and when released after a pinch or a lick is often undamaged. This difference in physique and temperament, coupled with similarity of superficial appearance, is difficult to explain by climatic action

5. Another class of facts telling against the argument now discussed is the production of the same effect in a variety of ways. The thin 'waists' of Hymenopterous insects are frequently mimicked in stout-bodied insects of other orders by either white colour or dense white pubescence which at a little distance effectively 'paints out' part of the body, leaving only a thin waist visible

6 It is usually found that mimetic resemblance only goes so far as is necessary to produce a *superficial* deceitful appearance, often the characteristic appearance of the group to which the mimic belongs may be found in or on parts which do not interfere with the mimetic resemblance

The antennæ of beetles which mimic other beetles might often be a hindrance; for whereas in the mimic the characteristic antennæ of its family may be long and thin, the antennæ of the distasteful model may be short and stout This difficulty is surmounted in the mimic by a thickening of the antennæ for a distance approximately equal to that of the thick antennæ of the model, the remaining segments of the long antennæ being thin and relatively inconspicuous The influence of external circumstances must here be very patchy!

7 Such examples of mimicry as the resemblance of large Sphingid caterpillars to some terrifying reptile with large eyes can scarcely be explained by the influence of climate.

8 It is somewhat difficult to understand why the explanation of mimicry by the action of natural selection has been a stumbling-block to many The fact that many insects escape their enemies by minutely resembling objects that are of no interest to them, such as a bird-dropping, is usually accepted as an example of the working of natural selection. Yet when the object that is of no or relatively little interest to the insectivorous creature is another insect, it has been claimed by some writers that natural selection cannot be the agent which has effected the resemblance Mimetic resemblances, as was long ago shown by Prof. Poulton, are only one example of various types of deceitful resemblance Natural selection will account for them all as well as for the examples of conspicuous 'warning' colours. Why, then, should it be thought necessary to invoke an explanation for one set of resemblances which is supposed to be powerless to account for others?

9 Prof. MacBride, in the article alluded to earlier, remarks that "it is assumed, often on very insufficient evidence, that the one of the two animals which is the commoner (*i e* the model) has some peculiar feature which makes it dangerous to the animals which would attack it, and that these learn to recognise it and avoid it"

It is true that when the theory of mimicry was first propounded there *was* very little direct evidence, but critics of the theory often seem to be unaware of the body of experimental and observational evidence that has been accumulated during recent years in the publications of the Entomological Society and others

It is sometimes a stumbling-block to critics that insects which are supposed to act as models have been seen to be devoured freely by certain enemies. For

example, I have myself obtained evidence that ants are a very important element in the food of Agamid lizards, and Danaine butterflies have been seen to be devoured by certain birds. In this connexion the old adage should be remembered, "One man's meat is another man's poison." It is important also to remember that not even the most enthusiastic supporter of mimicry claims that models are at all times and in all circumstances exempt from being devoured. I have seen the foul-smelling and evil-looking black 'Devil's coach-horse' beetle pulled out from among dead leaves by a wren in a wood and devoured in mid-winter. Edibility is entirely a question of the relative abundance of food: it is not without significance that mimetic resemblances reach their highest development in those parts of the world where insect life is most abundant.

10. Another stumbling-block may be given in Prof. MacBride's words: "It is held that the predatory animals mistake the defenceless species for the dangerous one, and that so the defenceless one escapes."

I do not think it is necessary to suppose this: all that is required for the protection of *B* is that it should sufficiently resemble *A* to remind the enemy of an unpleasant experience connected with an attempt to eat *A*. When food is abundant a very slight degree of resemblance to a creature known by previous experience to be unpleasant may save the life of another. This is within the bounds of human experience. Many people intensely dislike worms "because they wriggle so." Why should a wriggling movement be more unpleasant than, for example, the sudden leaping of a frog? Surely, because of man's origin, in countries where an instinctive dread of a snake was a criterion of life and death. It is not that we think worms *are* snakes, but they remind us of them. This point of view makes it much easier to understand cases where a mimic is much larger or smaller than its model, or where the resemblance is very elementary, or even depends but little upon colour but rather upon some trick of movement or posture.

In all such cases there is nothing in the theory of mimicry produced by selection of variations to prevent further improvement of the resemblances, nor on the other hand, is there any reason why a slight degree of resemblance *must* be perfected; all that is necessary is that the resemblance should remind an enemy of some previous unfortunate or unpleasing experience. Thus perfect and imperfect mimetic resemblances may exist together.

11. Finally, I would allude to the wonderful deceptive resemblances of the eggs of cuckoos to those of the nest in which they are placed.[1] In this case the enemy is the parent of the eggs resembled, which are the models. The phenomena are analogous to mimicry; there is a resemblance to something which the enemy will not attack; one theory will explain the evolution of both these classes of deceptive likeness. Can it possibly be claimed that these minutely detailed resemblances between eggs of birds are of a kind which supervene independently in the eggs of cuckoos and host-birds as a reaction to climatic conditions? The answer is, surely, 'No,' and the same answer may be given to the claim that "What happens in real 'mimicry' is apparently that individuals which have reached a certain stage in a reaction to climatic conditions are favoured by natural selection."

[1] See the papers by E. C. Stuart Baker, *Proc. Zool. Soc.*, 1923, p. 277, and F. C. R. Jourdain, *ibid.*, 1925, p. 639. See also presidential address to Ent. Soc. Lond., Jan. 20, 1926, by Prof. E. B. Poulton.

Diamond Jubilee of the Iron and Steel Institute.

THE May meeting of the Iron and Steel Institute, to be held this year on May 2 and 3, is of special significance inasmuch as the Institute is celebrating its diamond jubilee. The proposal for the formation of the Institute originated at a meeting of the Northern Iron Trade, held at Newcastle-on-Tyne on Sept. 29, 1868, and a committee was appointed with the object of giving effect to this suggestion. Mr. Isaac Lowthian Bell (as he then was) took a prominent part in the proceedings from the very beginning, and it was largely through his influence and efforts that the Institute took shape.

A provisional meeting was held in London in February 1869, at which the Institute was formally constituted, the Duke of Devonshire consenting to accept the position of president for the first two years. The inaugural meeting was held on June 23, 1869, in the Hall of the Society of Arts, when the noble president delivered a most interesting inaugural address, in which he traced the development of iron and steel manufacture. The next meeting of the Institute was held at Middlesbrough on Sept. 22 and 23 of that year, the first paper, appropriately enough, being by Mr. Isaac Lowthian Bell.

The Institute was by this time fairly formed, the first secretary being Mr. J. Jones and the first treasurer Mr. (afterwards Sir) David Dale. At the end of that year the Institute numbered 292 members; to-day the membership is just over 2700, and this numerical increase is good evidence that the work of the Institute has met a real need in the iron and steel industry. The object of this, as indeed of all similar technical societies, could scarcely be better stated than it was by the president in his inaugural address, when he declared the object of the Institute to be "the promotion of science in its practical applications rather than in its purely intellectual aspects," and it may fairly be said that this principle has been the dominating principle of the Institute.

The jubilee of the foundation of the Institute was celebrated by a banquet in the Guildhall on the evening of May 8, 1919, at which the then president of the Institute, Mr. Eugene Schneider, of the famous Creusot Works, presided, supported by a very distinguished company. As was not unnatural in the spring of 1919, the conclusion of the War was the thought uppermost in men's minds, and this fact so overshadowed the fact that this was the jubilee meeting of the Iron and Steel Institute that relatively little attention was paid to the fact that the Institute had then attained its half-centenary of existence. On this account the celebration of the diamond jubilee this year is likely to assume an even greater importance than it otherwise would.

It is interesting to note that there are still three members whose membership dates from the inaugural meeting of the Institute in London, namely, Sir Hugh Bell, Bart., himself a past-president and a Bessemer medallist, who joined the Institute at the same time as his father, the late Sir Isaac Lowthian Bell, Bart., who, as already pointed out, took a prominent part in the formation of the Institute; Mr. J. J. Bleckly, of the Pearson and Knowles Coal and Iron Co., Ltd.; and Mr. John Neilson, a nephew of the late James Beaumont Neilson, the inventor of the hot blast, which practically revolutionised the blast furnace practice of the world. The Institute can fairly claim to have counted among its list of members every one of the men who have been distinguished in the iron and steel industry for the last sixty years, and

the history of that industry and of its wonderful development is to be found in the *Journal* of the Iron and Steel Institute.

No one can doubt that the Institute will continue to go forward and prosper along the same lines traced out for it by its founders, which it has so consistently followed throughout the whole sixty years of its existence, and it seems almost superfluous to wish for a continuance of its prosperity for many years to come This wish will indeed be fervently re-echoed by everyone in Great Britain, seeing that the prosperity of the Iron and Steel Institute is bound up with the prosperity of the iron and steel industry, which in its turn is the foundation of the prosperity of the nation

The Stone Age in South-Eastern Asia.

RECENT research appears to point to more or less uniformity in the characteristics of the stone age cultures of south-eastern Asia. Investigations in French Indo-China by MM Mansuy and Patte and Mlle. Colani in the caves near the Bac-Son massif (Tonkin) yielded a large number of implements which these investigators regarded as relics of the oldest known stone age of Indo-China, classifying them as lower neolithic. Cord-marked pottery was also found, but regarded as belonging to a later phase of the neolithic. Evidence of similar stone age industries has been found in kitchen middens about twenty kilometres from Medan in the east coast province of Sumatra, and on the plains and lower hills of this province at sites always on the banks of rivers

In the *Journal of the Federated Malay States Museums*, vol. 12, Part 6, Mr I. H. N Evans reviews this material critically in relation to the results of recent excavations in caves in Perak The hypothesis of the French archæologists is that an early neolithic people, using roughly chipped implements only, came into contact with a people using polished implements, and from them adopted the practice of polishing the edges of their implements Mr. Evans, however, regards the chipped implements as a truly older palæolithic culture, surviving in association with the forms with polished edges which are proto-neoliths, the latter developing more and more to become a high neolithic culture. In Sumatra, iron weapons of a type still in use in north Sumatra in a layer immediately above that containing bouchers, with no sign of transition, pointed to a very late survival of a palæolithic culture.

In Perak, Mr. Evans, excavating with Dr. P. U. Van Stein Callenfels, of the Archæological Service of the Netherlands Indies, who carried out the investigations in Sumatra, found similar stone age cultures in caves near Lenggong (Upper Perak) and Padang Rengas (Kuala Kangsar). In the latter area the rock shelter, Gua Kĕrbau, contained human remains at a depth of 3·18 metres and below. Shellfish formed a large part of the diet of the inhabitants throughout the occupation. Flakes and chips occurred throughout, but the first palæolith was found in deposit *B*, the most common type being the *coup de poing* of almond shape. The first fragment of a proto-neolith occurred in layer *D* at a depth of 2·40 metres The lowest was found at 5·74 metres The proto-neoliths showed different stages of development. One might be classified as a middle neolith Grinding stones, grinding slabs, shells, some clearly, others probably, for use as amulets, and pottery in the upper layer were found.

Certain conclusions are offered tentatively Palæoliths, so-called Sumatra types, and proto-neoliths, are associated throughout; cord-marked pottery belongs to the later stages of palæo-proto-neolithic culture; the makers of proto-neoliths had older types of the neolithic culture as examples, and a palæolithic civilisation making use of 'Sumatra-type' implements spread at a certain period over south-east Asia, reaching even Sumatra, while the palæo-proto-neolithic stage also spread over the same area but did not reach Sumatra.

University and Educational Intelligence.

Leeds —The site is now being cleared for the new block for the Physics Department The accommodation will include two large laboratories, each about 5000 square feet in area, and a smaller laboratory for honours students; three lecture theatres for 250, 150, and 80 students respectively, and about thirty other rooms, the whole occupying a block about 100 feet square and comprising a basement and three floors over The building is estimated to cost about £47,400

London —Notice is given that applications for grants from the Thomas Smythe Hughes Fund for assisting medical research must reach the Academic Registrar, South Kensington, S W.7, by, at latest, June 15

St. Andrews —At a meeting of the University Court on April 19, it was intimated that Provost W. Norman Boase, St Andrews, had gifted to the United College the endowment fund for the institution of a residential entrance scholarship of £100 a year, tenable for three or four years by an entrant student resident in one of the residential halls of the United College, on conditions similar to those prescribed in the case of the Harkness, Russell, and Patrick Hamilton Entrance Scholarships As the Patrick Hamilton Scholarship was instituted in commemoration of the quater-centenary of Patrick Hamilton, the Martyr, a former student of the University, so the new scholarship is to be named the Montrose Scholarship in commemoration of the tercentenary of the studentship at St. Salvator's College of the great Marquis of Montrose

Applications for grants from the Dixon Fund of the University of London, for assistance in scientific investigations, must reach the Academic Registrar of the University, South Kensington, S.W.7, before May 15

A Busk Studentship in aeronautics, of the value of about £150 and tenable for one year from Oct. 1 next, for research in aeronautics and specially in stability problems, is being offered Forms of application, returnable not later than May 12, can be obtained from Prof B Melvill Jones, Engineering Laboratory, Cambridge

A fellowship of the value of £300 per annum for research on petroleum problems is being offered by the Institution of Petroleum Technologists. The fellowship will be tenable for one year, with a possible renewal for a further year Forms of application (returnable by June 1 at latest) are obtainable from the Secretary of the Institution, Aldine House, Bedford Street, W C 2

Applications are invited by the trustees of the Dickinson scholarships in connexion with the Manchester Royal Infirmary and the University of Manchester for the following A research travelling scholarship in medicine value £300, and a pathology scholarship value £75 Particulars may be had from the Secretary to the trustees, Royal Infirmary, Manchester The completed forms must be returned by May 2

Calendar of Patent Records.

April 27, 1844.—The aneroid barometer was the invention of a Frenchman, Lucien Vidie, and was patented in England in the name of De Fontainemoreau, merchant, of London, on April 27, 1844. The advantages that it possessed over the mercury instrument, especially as regards portability, were apparent directly its accuracy for general purposes had been tested, and it was soon extensively adopted, especially in Great Britain.

April 27, 1909.—The modern metal-spraying process for coating iron and steel is largely due to the Swiss chemical engineer, Dr. M. U. Schoop, whose first patent was applied for in Germany on April 27, 1909. The English patent was granted the following year.

April 28, 1784.—Stereotype printing was first introduced about 1726 by William Ged, but the earliest patent for the process was that granted to Alexander Tilloch and Andrew Foulis, printer to the University of Glasgow, on April 28, 1784. These and others of the early processes, though actually used for printing books, were only practised by the inventors themselves, and it was due to Lord Stanhope, who had been taught the art by Foulis, that the possibilities of the new method were generally realised. It was not, however, until the use of papier mâché for the matrix, in place of the plaster of paris formerly employed, was invented in France about 1828, that stereotyping was extensively adopted.

April 29, 1790.—On April 29, 1790, William Nicholson was granted a patent for the first rotary printing machine. Though the invention was not put into practice, it embodied suggestions which were successfully introduced by Koenig in his flat-bed cylinder machine of 1811, and by Applegarth in his rotary press some years later.

April 30, 1844.—The 'Lancashire' steam-boiler was the invention of Sir William Fairbairn and was patented by Fairbairn and John Hetherington on April 30, 1844. The boiler, which differs from its predecessor, the 'Cornish,' by having two tubular flues instead of one and by being internally fired, was the most economical one of its time, and by reason of its simplicity and its capacity of withstanding rough treatment, is still frequently preferred to other types for certain purposes.

May 1, 1704.—The use of jewelled pivot-holes in watches was the invention of Nicholas Facio de Duillier, a Swiss resident in London, and a fellow of the Royal Society, and a patent for it was granted to him in conjunction with two London watchmakers, Peter and Jacob Debaufre, on May 1, 1704. A petition presented to the House of Commons for the prolongation of the patent was successfully opposed by the Clockmakers' Company, but it has since been discovered that the evidence which was the principal factor in securing the rejection of the petition was not genuine, and was probably 'faked' for the occasion.

May 2, 1782.—Among the claimants for the new prizes offered by the Board of Longitude for improvements in the marine chronometer after the award of the original £20,000 to John Harrison in 1764, were the rival London watchmakers, John Arnold and Thomas Earnshaw, who share the right to be called the inventor of the modern chronometer escapement, though the exact share of each in the invention has not been satisfactorily determined. It is precisely Earnshaw's escapement that is now in universal use, but Arnold's construction is very similar, gives few points to the other, and was the first, by a year, to be patented, the date of the grant being May 2, 1782. Arnold was the first to manufacture chronometers on a commercial scale.

Societies and Academies.

London

Physical Society, Mar. 8.—**Ezer Griffiths** and **J. H. Awbery**: The dependence of the mobility of ions in air on the relative humidity. The apparatus employed was a modification of Zeleny's original method, the end of a wind channel being closed by a disc of gauze fitted with a guard ring through which a steady stream of air of definite humidity was pumped. The motion of the negative ions due to the action of the air stream was balanced by a counter potential gradient, and the mobility deduced from the critical potential required to produce a balance. The rate of air flow was measured by means of an Ewing ball and tube flowmeter, using a hollow glass sphere to make it suitable for low air rates. Efforts were made to construct a direct indicating instrument.—**A. M. Tyndall**, with a note by **C. F. Powell**: Some unsolved problems relating to the mobilities of gaseous ions. The address dealt with: (1) Established results and proposed theories; (2) the difference between positive and negative mobilities; (3) the effect of vapours; (4) mobility in pure gases; (5) positive ions of short age; (6) suggestions as to future progress. Note by Mr. C. F. Powell. An apparatus of the 'four gauze' type has been designed for experiments with highly purified gases.

Linnean Society, April 4.—**G. M. Graham**: The natural history of the Victoria Nyanza. The Fishing Survey of Lake Victoria, 1927–1928, was carried out, by the author and Mr. E. B. Worthington, to solve a problem in economic fisheries. This involved a study of the general ecology of the lake. The cichlid fish, *Tilapia esculenta*, is the most important food species, and next in importance is *T. variabilis*. Excluding the shore, the lake may be divided into certain ecological zones—(1) the surface waters; (2) the deep mud region (190-230 feet); (3) the intermediate zone (50-150 feet); (4*a*) shallow water (less than 50 feet) where the ground is exposed; (4*b*) shallow water where there is shelter. These zones are distinguished by their fauna. The tropical situation of the lake results in (1) a constant plankton population; (2) rapid growth and decay, with perhaps more virulent parasitism; (3) more or less continuous reproductive activity.—**G. P. Bidder**: On the classification of sponges. In 1927 reasons were shown for regarding Hexactinellida, on account of their naked cells, as forming a phylum separate from the horny, calcareous, and four-ray sponges, with no common ancestors below Choanoflagellata. The needle sponges are now put in the latter phylum, and a complete classification is given.

Paris.

Academy of Sciences, Mar. 18.—**P. Séjourné**: The line from Nice to Coni. Details of the construction of a new Alpine line, 63 kilometres long, more than one-third of which is tunnel.—**Henri Villat**: A fundamental problem of the theory of vortices.—**Charles Achard** was elected a member of the Section of Medicine and Surgery in the place of the late Fernand Widal.—**Paul Pelseneer**: Academic biostatistics. A comparison of the age at election, average years membership, and age at death of members of learned societies at Paris, Brussels, London, and Washington.—**Dubourdieu**: The topological invariants of networks of curves and surfaces.—**Etienne Halphen**: A theorem on quadrics analogous with that of Chasles on conics.—**Hadamard**: Observation on the preceding note.—**Paul Mentré**: The principal surfaces of complexes of right lines.—**J. A. Lappo-Danilevski**: The

singularities of integrals of systems of linear differential equations with arbitrary rational coefficients. —**Radu Badescu**: Abel's integral equation generalised.—**R. Gosse**: The determination of the equations $\delta = p\omega(x, y, z, q) + \theta(x, y, z, q)$, which admit an involution of order 2 and a second involution of higher order.—**Léon Pomey**: The integration of differential equations with general initial conditions (real variables).—**Ernest Esclangon**: The apparent displacements of the pole star. The Observatory of Strasbourg possesses a long series of observations of the pole star. An analysis of these data shows that the position of this star is not known with the precision desirable. The possible causes of this systematic error are considered.—**Albert Arnulf, A. C. S. Van Heel and Emile Perrin**: An optical method for the localisation of polished surfaces.—**Charles Guilbert**: A method of measuring very small electric currents, called tachymetric electrometry.—**R. de Mallemann**: Magnetic rotatory power in an anisotropic medium.—**Decombe**: Pulsating electrified spherical pellicles, the principle of areas, and the Zeeman phenomenon. —**A. Segay**: The inflammation of fire damp by explosives. Discussion of the effect of adding common salt to the explosive and of placing a small cartridge containing liquid carbon dioxide alongside the explosive.—**H. Caron and L. Vanbockstael**: A new isomorphous series of fluorine compounds. Mixtures of hydrofluosilicic acid, calcium chloride, and aluminium sulphate give octahedral crystals, the composition of which was found to be $4CaSiF6$, $8CaF_2$, $Al_2(SO_4)_3$, $45H_2O$. These are very slightly soluble in water and may be utilised in microchemical analysis as a test for calcium, aluminium, and sulphur.—**L. Neltner**: The extension of the Cambrian in south Morocco and the presence in this region of pre-Cambrian folds.—**J. Thoulet**: The Kurosio current of Japan.—**L. Eblé and J. Itié**: The values of the magnetic elements at the station of Val-Joyeux (Seine-et-Oise) on Jan. 1, 1929.—**Joseph Richard**: The antherozoids of *Fucus*.—**Theodureto de Camargo, R. Bolliger, and Paulo Correa de Mello**: The influence of the hydrogen ion concentration of the culture medium on the development of the coffee tree, *Coffea arabica*. The coffee plant develops best in acid media, the optimum acidity being between pH 4·2 and pH 5·1. The plant is very sensitive to the action of lime, a very small amount of which is distinctly harmful.—**W. Russell and L. Hedin**: New cisalpine African Leguminoseæ with secretory apparatus.—**Abeloos**: The influence of temperature on the growth of the *Planaria*. The maximum size is, for given conditions of nutrition, a function of the temperature and decreases notably when the temperature is raised. The speed of growth is a maximum at 12° C., smaller at 20° C., and still smaller at 8° C.—**Pierre P. Grassé and Mlle. Odette Tuzet**: The origin and nature of the supposed cephalic skeleton of sperm.—**G. Delamare and C. Gatti**: Spirochætes and treponemes from a venerian granulome.

Rome

Royal National Academy of the Lincei, Jan. 6.— **F. Severi and B. Segre**: A topological paradox.— **G. Giorgi**: The propagation of waves in media with selective absorption. By means of an example it is shown how physical phenomena which should depend on matrices of infinite order may be brought back to finite matrices combined with normal functional operators.—**U. Cisotti**: Certain space integrals in the complex plane.—**G. Fano**: An example of birational cubic transformation inherent to a linear complex.— **G. Fubini**: A problem of the theory of the congruences of straight lines, with applications to the problem of the spherical representation of a non-Euclidean surface and to a theorem of Bianchi and Blaschke.—**G. A. Crocco**: Considerations on the guiding of an aeroplane in cloud.—**G. Armellini**: The astronomical refraction at Rome. The results of a preliminary measurement indicate that at Rome the refraction constant C has a value slightly greater than 60·154″, and also that this varies somewhat with the season of the year; in virtue of its connexion with other modern astronomical questions, this phenomenon deserves further investigation. Application of the method of least squares to the data as yet obtained yields for C the value 60·51″, which lies between the number 60·15″ now adopted by the "Connaissance des Temps" of Paris and that now found at Abbadia, namely, 60·61″, and is, moreover, very nearly in agreement with the old value, 60·44″, given by Radau in the *Annales* of the Paris Observatory.—**S. Franchi**: The distant re-outcrop at a great height of the inverted nummulitic syncline of Valdieri.—**E. Bompiani**: Various determinations of the projective normals of a surface.— **G. Vitali**: Hamilton's principle. It is shown that this principle of classical mechanics may be written in a form which satisfies the following two conditions: (1) It should render evident the necessary invariance of the integral of which the variation is to be annulled by an invertible substitution on the integration variable, and (2) the system of Euler's equations into which the annulling of the variation of the integral is translated is changed into an equivalent when the integral is subjected to an invertible substitution on the system of four co-ordinates constituted initially of three Cartesian co-ordinates and of time. Further, a proof is given of the known fact that, for slow motions, Hamilton's principle is translatable with sufficient approximation into the system of equations of the geodetics of a space, the linear element of which is expressed by the elements figuring in the ordinary problem and by a constant c sufficiently great.—**M. Previatti Bortolozzi**: The equivalence of two equations presented in the determination of Vitali's principal terna for a generic surface of Hilbertian space.— **J. Kanitani**: An intrinsic quadratic form in relation to the hypersurface in projective space of several dimensions.—**P. Barreca**: Deduction of the experimental law of the duration of twilight colours of the clouds, and the probable discrimination between the theory of a macroscopic diffractive screen (terraqueous globe) and that of microscopic screens (dust). The author has previously shown deductively that the mean durations of the twilight colorations of the clouds are proportional to their respective wave-lengths and also to a number relating to the order of the annular spectrum surrounding the globe. A proof is now given of the theorem that, if in an isotropic medium there are two punctiform sources of monochromatic light, vibrating persistently from infinite time, and if, further, there are opaque screens of any form but similar geometrically in relation to the respective wave-lengths and situated similarly with respect to the sources, these produce diffraction fringes which are geometrically similar and situated similarly. —**A. Belluigi**: The form of deep, gravimetrically perturbing masses.—**M. Lombardini**: The viscosity of the air and the constant of surface friction at the experimental station of Vigna di Valle.—**M. Amadori**: Condensation products of p-phenetidine and glucose (2). Investigation of the two condensation products previously obtained shows that the condensation of a primary aromatic amine with glucose gives rise to (1) a compound of glucosidic character formed by the reaction of one hydrogen atom of the amino group with the hydroxyl of the glucose, and (2) a basic compound, resulting from the interaction of two

hydrogen atoms of the amino group with the ketonic oxygen of the aldehydic group or of the lactonic linking of the glucose —**R. Altschul** New method of impregnation with gold. In the impregnation of tissues with gold, the use of mercuric bromide together with gold chloride yields results quite different from those hitherto observed —**T Carpanese**: The prochlorite of Monte Rosso di Verra (Monte Rosa group). The dehydration of this specimen of prochlorite—which contains little iron—when heated follows a course perfectly analogous to that observed with pennine from Zermatt and with clinochlore from Val Devero The existence of a hydrate containing about 5 per cent of water and stable at 550°-700° C is indicated. Re-absorption of moisture from the air proceeds rapidly at first and then gradually slackens and ceases. The mineral undergoes optical transformation when heated, the optic axial angle being annulled and the sign changing to negative; afterwards biaxial character is assumed, the mineral remaining negative but with the plane of the optic axes perpendicular to the original position.—**P Principi** Outcrops of 'scaly clay' in Northern Umbria.—**L. De Caro** The isoelectric point of myoprotein and the regulating power of muscular juice. The regulating power of the muscle juice of *Emys*, *Scyllium*, and of the electric organ of the torpedo, measured by the ratio $\Delta B/\Delta p\mathrm{H}$, exhibits two minimum values at about $p\mathrm{H} = 7\ 7$ and 5 7 From the former value it increases rapidly on the alkaline side and from the latter on the acid side.—**B. Monterosso** Cirrepedological studies (5). Anabiosis and revivescence in *Chthamalus*.—**L. Mamoli**: The adenoid tissue in the normal human lachrymal gland. The characters of this tissue, as observed in fifteen living and sixteen dead individuals, varying from a six-months old fœtus to an octogenarian, are described —**P. Pasquini**: Phenomena of regulation and reparation in the development of the eye of amphibia (results of new experiments on the removal and transplantation of the optical vesicle in *Pleurodeles*, *Axolotl*, and *Rana*) The processes of compensatory regulation during the development of the optical vesicle in these organisms show, in their quality and degree, that this vesicle must be regarded as a specific equipotential and auto-differentiable system.—**L. Sanzo**: Egg and larva of the tunny (*Orcynus thynnus* Ltkn)—**B. Strampelli**: Significance of the Heinz-Ehrlich bodies, and their relations between macrophagic and myeloplaxic apparatus.

Official Publications Received.

BRITISH

Air Ministry Aeronautical Research Committee. Reports and Memoranda No 1170 (Ae 334) Report of the Air-worthiness of Semi-rigid Airships Sub-Committee (T 2668) Pp 16+1 plate 9*d* net No 1188 (Ae 350) Full Scale Experiments with a Bristol Fighter fitted with Slots and Flaps and Slot and Aileron Control By K V Wright (T 2639) Pp 6+6 plates 9*d* net (London H M Stationery Office)

Proceedings of the Royal Society of Edinburgh, Session 1928–1929 Vol 49, Part 1, No 5 The General Expression for Boundary Conditions and the Limits of Correlation By J Ridley Thompson Pp 65-71 6*d* Vol 49, Part 1, No 6 Mental Measurements, the Probable Error of some Boundary Conditions in Diagnosing the Presence of Group and General Factors By Thomas P Black Pp 72-77 6*d* Vol 49, Part 1, No 8 The Photochemical Equilibrium between Hydrogen, Bromine and Hydrogen Bromide By R W Armour and E B Ludlam Pp 91-101 1*s* Vol 49, Part 2, No 9 On the Relation of Fertility in Fowls to the Amount of Testicular Material and Density of Sperm Suspension By F B Hutt Pp 102-117 1*s* 3*d* (Edinburgh Robert Grant and Son; London Williams and Norgate, Ltd)

Department of Scientific and Industrial Research Building Science Abstracts Compiled by the Building Research Station and published in conjunction with the Institute of Builders Vol 2 (New Series), No 2, February Abstracts Nos 201-399 Pp v+55-95 (London H M Stationery Office) 9*d* net

Imperial Department of Agriculture for the West Indies Report on the Agricultural Department, Dominica, 1927–28 Pp iv+48 (Trinidad) 6*d*

Board of Education Vacation Courses in England and Wales and Scotland, 1929 Pp 26 (London H M Stationery Office) 6*d* net

FOREIGN

Department of Commerce U S Coast and Geodetic Survey Special Publication No 150 Tides and Currents in Portsmouth Harbor By A J Hoskinson and E A Le Lacheur Pp vi+98 20 cents Special Publication No 153 Conformal Protection of the Sphere within a Square By Oscar S Adams Pp 13 5 cents (Washington, D C Government Printing Office)

Ministry of Agriculture, Egypt Technical and Scientific Service Bulletin No 77 Preliminary Experiments with Dusting and Spraying against Insect Pests of Cotton By Ibrahim Eff Bishara Pp 11+3 plates (Cairo Government Press) 5 P T

Proceedings of the United States National Museum Vol 74 Art 10 Tropical American Diptera or Two-winged Flies of the Family Dolichopodidae from Central and South America By M C Van Duzee (No 2755) Pp 64+2 plates Vol 74, Art 19 Further Studies of Types of American Muscoid Flies in the Collection of the Vienna Natural History Museum By J M Aldrich (No 2764) Pp 34 Vol 75, Art 3 On some New and Interesting Species of Water Beetles of the Family Gyrinidae in the United States National Museum By Georg Ochs (No 2774) Pp 6 (Washington, D C Government Printing Office)

Comite National Français de Geodésie et Geophysique Assemblée generale du 2 juillet 1928 Compte rendu publie par le Secretaire general G Perrier Pp 59 (Paris)

CATALOGUES

Catalogue of Important Works Pre-Linnean, Old Herbals, and Modern Botany, Birds, Microscopy, Fossils, Insects, and General Literature (No 8) Pp 16 (London. John H Knowles)

The Products of X-Rays, Ltd Pp 104 (London. X-Rays, Ltd)

Hilger Spectroscopically Standardised Substances (H S Brand) Pp 4 (London Adam Hilger, Ltd)

Classified List of Second-Hand Scientific Instruments (No 94, April) Pp vi+58 (London C Baker)

Steel Office Furniture (List No 454) Pp 12 (London G A. Harvey and Co, Ltd)

Diary of Societies.

FRIDAY, APRIL 26

ROYAL SANITARY INSTITUTE (at City Hall, Cardiff), at 3 —R M F. Picken and E C Williams The New Local Government Act — A N J Sair Some Notes on Town Planning —T H Morris The Proposed Reconstruction, Widening, and Lowering of Cardiff Bridge

PHYSICAL SOCIETY (at Imperial College of Science), at 5 —T Smith, Dr G F. C Searle, Instructor-Capt T Y Baker, Dr J W French, W E Williams, C G Vernon, H. H Emsley, C. W Hansel, H Tunley, L Moore, Conrad Beck, V T Saunders, and Dr C V Drysdale Discussion on The Teaching of Geometrical Optics

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5

ARMSTRONG COLLEGE MINING SOCIETY (at Armstrong College, Newcastle-upon-Tyne), at 7 —J S Carson and others Discussion on Iron and Steel Supports in Mines

ROYAL INSTITUTION OF GREAT BRITAIN, at 7 —E A Salt Platinotype

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at University College, Dundee), at 7.30 —W Holmes Load-levelling Relays and their Application in connexion with Future Metering Problems

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8 —Dr J. G Thomson Endemic Malaria in Southern Rhodesia

BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (at National Institute of Industrial Psychology), at 8 —J N. Langdon Evidence of a Central Factor in Tests of Manual Dexterity

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Prof R W. Chambers English Civilisation from Alfred to Harold, 900–1066

INSTITUTE OF BREWING (North of England Section) (at Midland Hotel, Manchester) —F M Maynard A Tropical Brewery —H Abbot Some Bottling Notes

INSTITUTION OF CHEMICAL ENGINEERS (Graduates' and Students' Section)

SATURDAY, APRIL 27

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates' and Students' Section) (at Newcastle-upon Tyne), at 2 45 —J T Whetton The Optics of Surveying Instruments and Tacheometric Surveying

PHYSIOLOGICAL SOCIETY (in Department of Physiology, Cambridge), at 3. —F Bremer Contractile Duality of Skeletal Muscle —F D Ingraham and Dr. J F Fulton Emotional Disturbances following Experimental Lesions of the Base of the Brain (prechiasmal) —Dr J S Haldane The Dissociation and Reformation of Oxyhæmoglobin and Bicarbonate in Blood within the Living Body —A J Canny, Prof E B Verney, and Dr F R Winton The Double Heart-Lung-Kidney Preparation — Prof E B Verney and Dr F R Winton The Action of Caffeine on the Isolated Kidney of the Dog —A Szent Gyorgyi and A N Drury The Influence upon the Heart of Substances related to Nucleic Acid — A Walton The Effect of Temperature on Surviving Mammalian Spermatozoa *in vitro* —J Y Bogue and R Mendez The Mechanical and Electrical Response of the Frog's Heart —I Mazcu Evidence in Favour of the Existence of Depressor Fibres in Secretory Nerves — H Hausler Hot Wire Analysis of the Effect of Drugs on the Coronary System.—Dr G V Anrep, I Mazcu, and J Stella Vaso-motor Reactions of the Coronary System —C W Bellerby (*a*) The Relation of the Anterior Lobe of the Pituitary to Ovulation, (*b*) The Physiological Properties of Anterior Lobe Pituitary Extracts —J M R Innes and C W Bellerby Spontaneous Deciduomata in the Rat — J S Patel and B. P Wiesner The β Hormone —B P Wiesner Further Studies on Pituitary Extracts.—Demonstrations —B H C Matthews A Portable Electrocardiograph —F Bremer Myographic Records illustrating—(*a*) Summation of Impulses, (*b*) Contractile Duality of Skeletal Muscle —J Hammond and Dr. F H A Marshall

A Comparison of the Pseudopregnant and Pregnant Changes in the Ferret —Prof E D Adrian The Discharge of Sense Organs and of Motor Neurones —A N Drury and A Szent Gyorgyi The Influence of Adenosine upon the Heart —A Walton The Effect of Temperature on Surviving Mammalian Spermatozoa *in vitro* —J R M Innes and C W Bellerby Changes in the Ovary of the Rabbit following Injections of Anterior Lobe Pituitary Extract —H Florey and C W Bellerby Ovulation in the Unmated, Hypophysectomised Rabbit —H B Fell and R Robison Growth and Differentiation of Explanted Skeletal Tissue —R Hill Spectrocolorimeter —H Florey and Prof J Barcroft Effect of Exercise on Exteriorised Intestine —Prof J Barcroft Bottles for Differential Absorptiometer —E C Smith Critical Limits in the Drying and Freezing of Muscle —H Barcroft The Effect of Adrenalin on the Output of the Heart as Measured by the Mechanical Stromuhr —J Izquierdo Apparatus for Measurement of Effect of Temperature on Pulse of Frog —H Taylor and Prof J Barcroft Effect of HCN on Respiration

MONDAY, April 29

Institute of Actuaries, at 5 —J. G. Parker Financial Conditions in Canada as affecting Life Assurance

Society of Dyers and Colourists (Manchester Section) (Annual Meeting) (at 36 George Street, Manchester), at 7 —H H Hodgson Colour and Constitution from the Standpoint of Recent Electronic Theory

Institution of Automobile Engineers (Scottish Centre) (at Royal Technical College, Glasgow), at 7 30 —W P Kirkwood Brakes

Royal Society of Arts, at 8 —Sir E Denison Ross Nomadic Movements in Asia (Cantor Lectures) (III)

Royal Geographical Society (at Eolian Hall), at 8 30 —W R Rickmers The Alai-Pamirs in 1913 and 1928

Zoological Society of London (Centenary Celebration) (at University College)

TUESDAY, April 30

Royal College of Physicians of London, at 5 —Dr F M R Walshe The Physiological Analysis of some Clinically Observed Disorders of Movement (Oliver-Sharpey Lectures) (I)

Illuminating Engineering Society (in Lecture Theatre of Holophane, Ltd , Elverton Street, S W 1), at 6 30 —Dr S English Some Further Properties of Glass and their Application to Illuminating Engineering (Lecture) —At 8 45 —R G Williams Demonstration of Various Novel Applications of Coloured Light

Royal Photographic Society of Great Britain (Scientific and Technical Group), at 7 —Dr W Clark A Talk about the Kodacolor Process, with Demonstration —F. J Tritton A Method of Increasing the Printing Speed of Dichromated Gelatin

WEDNESDAY, May 1

Royal Institution of Great Britain, at 5 —Annual Meeting

Royal Society of Medicine, at 5 —Annual General Meeting

Institution of Electrical Engineers (Wireless Section), at 6 —Dr J Hollingworth and R Naismith A Portable Radio Intensity Measuring Apparatus for High Frequencies

Institution of Automobile Engineers (Birmingham and Coventry Graduates) (at Queen's Hotel, Birmingham), at 7 30 —H. R Ricardo High-speed Diesel Engines

Society of Public Analysts and other Analytical Chemists (at Chemical Society) at 8 —Dr R S Morrell and S Marks The Determination of Organic Peroxides —J W Croxford Differential Halogen Absorption of Oils and Fats —Dr. W R Schoeller and C Jahn A New Method for the Separation of Small Quantities of Tantalum and Niobium from Titanium —H R Ambler The Analysis of Small Samples of Gas

Royal Society of Arts, at 8 — P M Horder Architectural Models

Entomological Society of London, at 8

Royal Society of Medicine (Surgery Section), at 8 30 —Annual General Meeting

Royal Society of Medicine (Surgery and Medicine Sections), at 8 30 —A J Walton (Surgery), Dr H Thursfield (Medicine), and others Discussion on The Indications for and the Results of Splenectomy

THURSDAY, May 2

Iron and Steel Institute (Annual Meeting) (at Institution of Civil Engineers), at 10 a m —Presentation of Bessemer Gold Medal to The Hon Sir Charles Parsons —Prof H Louis Presidential Address —Papers for discussion —First Report on Blast Furnace Plant and Practice, by a Committee of the Institute —E H Lewis Twenty Months' Results of Dry Blast Operation —W E Simons The A I B Sinter Plant at Messrs Guest, Keen and Nettlefolds, Ltd , Cardiff Works —At 2 30 —R H Greaves, H H Abram, and S H Rees The Erosion of Guns —H Sutton The Influence of Pickling Operations on the Properties of Steel —G A Hankins and Miss G W Ford The Mechanical and Metallurgical Properties of Spring Steels as Revealed by Laboratory Tests

Royal Society, at 4 —Election of Fellows —At 4 30 —Dr J S Haldane, W Hancock, and A G R Whitehouse The Loss of Water and Salts through the Skin, and the corresponding Physiological Adjustments —Dr F H A Marshall and J Hammond Œstrus and Pseudo-Pregnancy in the Ferret —R G Canti and F G Spear The Effect of Gamma Irradiation on Cell Division in Tissue Culture *in vitro* —R B Bourdillon, C Fischmann, R G C Jenkins, and T A Webster The Absorption Spectrum of Vitamin D —*Papers to be read in title only* —G E. Briggs Experimental Researches on Vegetable Assimilation and Respiration XX.—R J Lythgoe and K Tansley The Relation of the Critical Frequency of Flicker to the Adaptation of the Eye —R Hill Reduced Hæmatin and Hæmochromogen

Linnean Society of London, at 5 —H H Haines Some Aspects of the New Forest, with Special Reference to the Changes Wrought by Direct or Indirect Human Agency —F S Russell · A General Account of the Great Barrier Reef Expedition and its Aims —G Tandy A Preliminary Account of the Vegetation of Low Isles (The Great Barrier Reef Expedition) —H W. Pugsley A Revision of the British Euphrasias (*By title only*)

Institute of Pathology and Research (St Mary's Hospital, W 2), at 5 —Prof C A Ariens Kappers The Phylogenetic Development of the Protopathic and Epicritic Centres in the Central Nervous System

Royal College of Physicians of London, at 5 —Dr F M R Walshe The Physiological Analysis of some Clinically Observed Disorders of Movement (Oliver-Sharpey Lectures) (II)

Chemical Society, at 8 —Prof I M Heilbron, W M Owens, and I A Simpson The Unsaponifiable Matter from the Oils of Elasmobranch Fish Part V The Constitution of Squalene as deduced from its Degradation Products —Prof I M Heilbron and A Thompson The Unsaponifiable Matter from the Oils of Elasmobranch Fish Part VI The Constitution of Squalene as deduced from a Study of the Decahydrosqualenes —Prof I M Heilbron and W A Sexton Studies in the Sterol Group Part III The Acetylation and Catalytic Hydrogenation of Ergosterol —Prof I M Heilbron, W A Sexton, and F S Spring Studies in the Sterol Group Part IV The Existence of Isomeric naturally occurring Ergosterols —Prof I M Heilbron and F Irving Styrypyrylium Salts Part XI The Determination of the Reactive Group in Ketones of the Type CH_3 CO CH_2R by means of the Benzo-β-naphthaspiropyran Colour Change —G A R Kon and R P Linstead Catalytic Influences in Three Carbon Tautomerism Part I Sodium Alkyloxides

Royal Society of Medicine (Tropical Diseases Section), at 8 15 —Annual General Meeting

FRIDAY, May 3

Iron and Steel Institute (Annual Meeting) (at Institution of Civil Engineers), at 10 a m —Announcement of the award of the Andrew Carnegie Research Scholarships for 1929-30 —Presentation of the Carnegie Gold Medal to Dr A Bramley —The Hon Sir Charles Parsons and H M Duncan A New Method for the Production of Sound Steel —Third Report on Heterogeneity of Steel Ingots, by a Committee of the Institute —J M Robertson The Microstructure of Rapidly Cooled Steel —D Lewis The Transformation of Austenite into Martensite in a 0 8 per cent Carbon Steel —A L Norbury Constitutional Diagrams for Cast Irons and Quenched Steels —At 2 30 —G R Bolsover Brittleness in Mild Steel —L B Pfeil The Oxidation of Iron and Steel at High Temperatures —E G Herbert and P Whitaker The Differential Method for Measuring the Thickness of Hard Cases without Sectioning them —T E Rooney and G Barr A Method for the Estimation of Hydrogen in Steel

Royal Society of Medicine (Otology Section) (Annual General Meeting), at 10 30 a m —T Neville Treatment of Chronic Deafness by Diathermy and Ionisation

Royal Astronomical Society (Geophysical Discussion), at 4 30 —Cloud Formation C J P Cave, Sir Gilbert Walker Chairman, Sir Frank Dyson

Royal Society of Medicine (Laryngology Section) (Annual General Meeting), at 5 —F J Clemınson Treatment of Carcinoma of the Œsophagus by Radium

Philological Society (at University College), at 5 30 —Anniversary Meeting

Institution of Electrical Engineers (Meter and Instrument Section), at 7 —G D Malcolm Chairman's Address

Institution of Mechanical Engineers (Informal Meeting), at 7 —H Berry London's Water

Geologists' Association (at University College), at 7 30 —Dr S W Wooldridge and A J Bull The Arun Gap and Lower Greensand around Pulborough

Institution of Automobile Engineers (jointly with Institution of Production Engineers) (at Royal Society of Arts), at 7 45 —H F L Orcutt The Production and Application of Ground Gears (Lecture)

Royal Society of Medicine (Anæsthetics Section) (Annual General Meeting), at 8 30 —Dr H Sington Pre-medication by Paraldehyde in Children

Royal Institution of Great Britain, at 9 —Sir Daniel Hall The Garden Tulip

PUBLIC LECTURES.

FRIDAY, April 26

World Association for Adult Education (16 Russell Square, W C 1), at 8 30 —Miss R M. Fleming Soil and Civilisation in Russia

MONDAY, April 29

Bedford College for Women, at 5 15 —Dr V Stefansson Abolishing the Arctic

University College, at 5 15 —Prof E Mellanby Drug-like Actions of some Food Constituents (Succeeding Lectures on April 30 and May 1)—At 5 30 —Prof H F Baker Geometry a Brief Review (Succeeding Lectures on May 7 and 13)

WEDNESDAY, May 1

Bedford College for Women, at 5 15 —Dr V Stefansson The Northward Course of Empire

THURSDAY, May 2

St Thomas's Hospital, at 5 —Prof S J Cowell Dietetics (Succeeding Lectures on May 9, 16, 23, 30, and June 6)

University College, at 5 —R J Lythgoe Special Sense Physiology (Succeeding Lectures on May 9, 16, 23, 30, and June 6)

FRIDAY, May 3

University College, at 4 —Prof A J Hall Some of the Sequels of Epidemic Encephalitis (Lethargica) —At 5 30 (Succeeding Lecture on May 10)—Prof R Robinson Public Inaugural Lecture

Imperial College of Science and Technology, at 5 30 —Prof F O Bower The Origin of a Land Flora reviewed 21 Years after Publication (Huxley Memorial Lecture)

SATURDAY, MAY 4, 1929.

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The New University of London.

THE title of this article is not intended to imply any disrespect for the 'old' University of London in any of its previous incarnations. In accordance with the new statutes under the University of London Act of 1926, sealed by the Privy Council on Mar. 21, the University is going through a process to which the now familiar word 'rejuvenescence' would perhaps be more appropriate than 're-birth', for the University, established in 1836, is not old as such institutions go, and shows few of the stigmata of senility. But all institutions of the kind live a rhythmical life, and require periodic adjustment to changing conditions. This is the third time that the University of London has received special attention from the Government of the day, and we may question whether the proverbial attribute of the 'third time' will be confirmed in this case.

The original charter incorporated persons of eminence in arts and science for the purpose of awarding degrees to students of University College and King's College and other colleges which might become affiliated. In 1858, a new charter created Convocation and granted to the graduates important privileges in relation to the government of the University. At the same time, the system of affiliating colleges was virtually abandoned, being replaced by the policy of the 'open door'. In 1900, after a spate of argument, new statutes, based on the Act of 1898, erected the loosely jointed framework of a teaching University; and now, after another spate of argument, the attempt has been made to quicken the life of the University, without altering its essential character.

What is the essential character of the University of London? Like its medieval prototypes, it is a self-governing guild of teachers, graduates, and students. Let us not forget that the medieval university was a research as well as a teaching institution. The fellowship system originated in a desire to promote study, and not to promote teaching; indeed, the founder of Queen's College, Oxford, expressly declared that he intended his benefaction to relieve his fellows from the necessity of teaching. At Oxford and Cambridge the collegiate system was a later development, an afterthought, due to domestic rather than to educational considerations, and those universities have outgrown the misconception of a university as a federation of colleges, a misconception which impeded their progress for some centuries. The present is surely an inopportune moment to force

forward, as some influential members of that University are doing, an alien conception of the University as a "federation of autonomous institutions" It is true that, under the new statutes, the link between the University and its colleges has been strengthened, but the University exists apart from its colleges, and must be free to live its own life, to do its peculiar work for the extension of higher education and research, whether directly or through existing agencies or through new agencies This obligation is emphasised rather than weakened by the new arrangements to be made by the Government and by the London County Council for the allocation by the University of public grants for university education within the London area If the University is to be merely a clearing-house for autonomous colleges, it can never hope to gain the public esteem to which the university of the metropolis of the Empire should be entitled

Readers of NATURE are specially interested in the promotion of scientific research, and an application of our thesis is ready to hand One of the current controversies in the University relates to the promotion of scientific research Should it be concentrated in the colleges in close touch with undergraduate teaching or stimulated and developed by the creation of a series of research institutes, as at Cambridge? The best way to deal with a dilemma is often to adopt both alternatives For our part, while recognising that every encouragement must be given to the prosecution of scientific research in the colleges, we are not satisfied that the University will make its due contribution to scientific discovery if it restricts its research work in this way

That we are not discussing the question *in vacuo* is indicated by a report of the Site and Buildings Committee received by the Senate of the University on Jan. 23 on the utilisation of the Bloomsbury site of about eleven acres It is proposed to allocate a large part of the area to residential purposes, but the Committee "do not at present propose that the University should build laboratories" There is no evidence that the professors wish to live next-door to one another on one of the most valuable sites in the world It is not a London characteristic. But if the reference in the sentence quoted from the Committee's report is to laboratories for scientific research, we would urge the new Senate to announce at the earliest moment an intention on the part of the University to build on the Bloomsbury site a great Temple of Science, to use Lord Rosebery's phrase, dedicated to the silent pursuit of scientific truth, a noble counterpart of St Paul's Cathedral. As Mr H G Wells has well said, the University of London has "to supply facilities for research upon an altogether unprecedented scale, it has to maintain itself as the intellectual centre of the entire Empire"

The question of the promotion of scientific research will be one of the most important facing the new Senate, now in process of election, and of the subordinate Faculty of Science and Boards of Students Electors, whether teachers or graduates of the University—each category is to contribute seventeen members to the Senate, making together two-thirds of the membership—should recognise their serious responsibility in this matter Men and women are required capable of rising above the jealousies and intrigues which have hindered the progress of the University in the past, capable of taking a synoptic view of the needs and problems of university education in London, of pressing steadily forward to a clearly defined conception of the university which London ought to possess

There are many questions relating to the organisation of the new University of London which might be usefully discussed, such as the question of the University area, the work of the University in extending higher education—it is difficult to understand why the vast area of London 'across the bridges' is almost *terra incognita* as regards university education—the popularisation of knowledge, the cultivation of art, music, and the drama, the founding of a great school of law, the creation of a great international centre for the exchange of thought and practice, the provision of a great meeting-place for conferences of all kinds bearing on education, science, economics, government, national and Imperial development We prefer, however, to stress the importance of the elections to the Senate as the dominating issue at the moment

For the first time in its history the University of London, thanks to the Rockefeller Foundation and to the Government, has its own land on which it can build its buildings and discharge its purposes, not the least important of which is, to quote from the new statutes, "to promote research and the advancement of science and learning" May Henry VIII's wise words, addressed to the University of Oxford, prove true in the case of the University of London "I tell you, sirs, that I judge no land in England better bestowed than that which is given to our Universities, for by their maintenance our Realm shall be well governed when we are dead and rotten"

Travellers' Tales.

(1) *The Book of the Marvels of India* By Buzurg Ibn Shahriyar From the Arabic by L Marcel Devic Translated into English by Peter Quennell (The Golden Dragon Library.) Pp. vi + 164 (London George Routledge and Sons, Ltd , 1928) 6*s* net

(2) The Broadway Travellers' Series *Hans Staden the True History of his Captivity, 1557* Translated and edited by Malcolm Letts, with an Introduction and Notes Pp xx + 191 10*s* 6*d* net *Thomas Gage, the English-American a New Survey of the West Indies, 1648.* Edited with an Introduction by Dr A P. Newton Pp xxxii + 407 + 12 plates 15*s* net *Travels in Persia, 1627–1629* By Thomas Herbert Abridged and edited by Sir William Foster, with an Introduction and Notes Pp. xl + 352 + 13 plates 15*s*. net (London George Routledge and Sons, Ltd , 1928)

(3) *Adventures of an African Slaver · being a True Account of the Life of Captain Theodore Canot, Trader in Gold, Ivory, and Slaves on the Coast of Guinea , his Own Story as told in the Year 1854 to Brantz Mayer, and now edited with an Introduction by Malcolm Cowley* Pp xxii + 376 + 9 plates (London George Routledge and Sons, Ltd , 1928) 15*s* net

WHY is it that nine out of ten modern books of travel are intensely dull and yet early travels never seem to fail in their appeal to the imagination or their hold on the attention of the reader ? This is equally true whether they break what, in their author's time, was new ground, or follow a beaten track In all these books under notice there is scarcely a dull page

(1) "The Book of the Marvels of India" calls for no extended comment, though it is infinitely entertaining It is a collection of stories current among Arab seafarers in medieval times, full of marvels described with a wealth of detail and here and there a sly touch of humour It was obviously on some common stock that the authors of Sindbad in the "Arabian Nights," of Sir John Mandeville, the author of this collection, and other writers of similar tastes, drew for their accounts of the wonders of the East The roc the old man of the sea, the island of women, and other familiar marvels, will be found here, but in such a form as not entirely to preclude a remote foundation in reality

(2) This, with the two volumes mentioned next in order, is issued in the excellent series of Broadway Travellers, for which we are indebted to the scholarship of Sir E. Denison Ross In this series the travels selected for publication have been chosen with much discrimination, while in illustration, type, and form, the series as a whole is very pleasing

Hans Staden's account of his captivity among the Indians of Brazil is a remarkable document. A Dutchman of the middle sixteenth century who served the Portuguese as a gunner, he visited Brazil twice, being captured on the second occasion. The Indians, whom he usually but not invariably calls Tupinambu, made a practice of eating their prisoners if they were Portuguese Staden barely escaped that fate He gives a unique account of the details of their method of procedure

Thomas Gage, the author of the "English-American," was a man of very different type. Educated as a Jesuit in France and Spain, he became a Dominican and went to America, where he stayed for twelve years as a missionary His book, written on his return to England, was the first authentic account of Spanish America and the West Indies to be written in English It had a great vogue in the seventeenth century, dropped into oblivion, and had not since been reprinted. This was no doubt due to the fact that, the author having changed his religion, his theological polemic as well as his narrative were used by the Commonwealth as propaganda against Spain and caused the very real merits of part of his work to be forgotten The editor has judiciously excised those parts of his book which make no appeal to the modern reader

Gage was scarcely an admirable character—he acted as informer against his former co-religionists—and it is characteristic of the man that he expects much of what he has to say not to be believed.

Herbert, author of "Travels in Persia," accompanied Sir Dodmore Cotton on the embassy to Shah Abbas in 1627, and was thus the precursor of Tavernier, de Chardin, and other great travellers of the seventeenth century. He returned to England in 1629, and published his book in 1633. He afterwards issued several enlarged editions. The book is of considerable historical importance, as it is the only detailed account of the first English embassy to Persia Herbert had a good opportunity of seeing something of the country, as not only was the embassy compelled to make a stay of some length, but also, owing to the absence of the Shah from his capital on their arrival, they had to follow him so far as Kasvin Herbert was an acute, if not very profound, observer, and gives a very good account of the Persia of that day His

observations of the peoples seen at the ports at which they touched on the voyage around the Cape are also of considerable interest

(3) "Adventures of an African Slaver" is noteworthy as a graphic account of conditions in the slave trade in the earliest part of the nineteenth century when it had been prohibited, transcribed from the oral narrative of the protagonist by an American journalist It is absorbing, if rather horrifying, as a story and valuable as a historical document.

The Movements of Plants.

The Motor Mechanism of Plants By Sir Jagadis Chunder Bose. Pp xxv+429. (London, New York and Toronto Longmans, Green and Co, Ltd, 1928) 21*s* net

IT is safe to assume that there are certain fundamental resemblances in the behaviour of all living cells in virtue of their possessing the same ground plan of protoplasmic structure, and among all aerobic cells in virtue of a similar oxidative mechanism, as the recent work of Keilin suggests Among all animal contractile cells, again, there are general resemblances When, therefore, we consider the observations of Sir Jagadis Bose on plant movements from the point of view of general physiology, we have to decide whether the resemblances he finds are merely common properties of living protoplasm as such, or of excitable protoplasm, or contractile protoplasm, and whether there are specific differences between the processes of animal and plant

In the present work, as in all the work of Sir Jagadis Bose, the apparatus and methods used combine delicacy and simplicity in a delightful way For example, nothing could be neater than the various types of tapping recorder described on pp. 16-28, for writing without friction on a smoked surface and in the same process making a time record. Another ingenious device is the 'quadrant' method for recording the change in electrical resistance of a leaf on exposure to light (p 194) A circular leaf is connected up to a battery and galvanometer by four leads so that the leaf is divided into quadrants, each of which forms one arm of a Wheatstone's bridge By adjusting the position of one contact the bridge resistances are balanced Two opposite quadrants can be exposed to light while the others are kept in the dark by a screen cut to the correct shape. If the illuminated quadrants vary in resistance, the galvanometer deflection will be proportional to the product of the changes, so that a method of high sensitivity is obtained with a minimum of apparatus

The use of this device illustrates the chief defect in this work, the lack of experimental controls The galvanometer deflections are taken at their face value as measuring change of resistance without any inquiry as to whether the 'action current' of the excited tissue may not be a complicating factor So far as the description goes, this method, and another one mentioned, may be simply rather roundabout ways of recording the action current The great similarity of the curves in 'resistance' and of electrical change lends colour to this suspicion

Some other points in the book where similar criticism is called for may as well be dealt with at once Be it understood that criticism is directed solely against the case as presented in the volume under notice, Sir Jagadis must not blame the reader for ignoring other evidence which is not quoted The first case is the use made of the very ingenious magnetic method for magnifying the movement of a lever By this method a movement can be magnified ten million times (p 346) At this magnification temperature control to 0 01° C would seem to be called for, but no indication is given that a thermostat was used at all Using this instrument, an oscillatory response was obtained in stems in which there was an active flow of sap The oscillations might have been due to the natural period of the instrument They were probably not, but no evidence is given on the matter Again, if the oscillations are genuine their period should correspond with that of the electrical changes described previously, and changes in amplitude should be in the same direction in both cases, but no information of this sort is given, so that the results must be accepted with reserve.

In Chapter IX. experiments are described on excitation with constant current Owing to the slow conduction of excitation, it is easy to see from which electrode the excitation process starts in any plant that makes an obvious movement With currents near the threshold potential, excitation occurs at the cathode at the make of the current only, with rather stronger currents up to about twice the threshold value, excitation occurs also at the anode at the break This is strictly according to the behaviour of animal tissues. With stronger currents, however, there is excitation also at the anode at the make, with stronger still at the cathode at the break If these results were taken at their face value, as the author intends them to be, they would imply the existence of a new type of excitation process, but the data do not warrant such an extreme

conclusion When a current is passed through a tissue with cells arranged in series as well as in parallel, each cell in the region of the flow has a cathodal and anodal region With weak currents a few cells only near each external electrode will be subjected to a potential approaching the threshold value, and the probability is that cells near the external cathode will experience the highest potential at their cathodal end and those near the anode at their anodal end, and will be excited accordingly. With potentials above that required to excite at the external anode at the break, some of the cells near the external anode may have local cathodes at which excitation occurs, and correspondingly near the external cathode There is no reason to doubt the observations, but good reason to doubt the naive conclusions drawn from them.

In several of the experiments described in Chapters xiii. and xiv , which deal with the electric response on stimulation, positive galvanometer deflections were found as well as negative These positive deflections are interpreted as genuine action currents in the opposite direction to the usual action current In every case, apparently, both electrodes were placed on functional tissue, but as one was in contact with a more obviously active region, it is assumed that all galvanometer deflections were due to changes in that region, and that no changes occurred elsewhere that could affect the other electrode This seems a rash assumption, and it is a pity it was apparently not tested, as it easily could have been by placing the second electrode on killed tissue It is true that several observers have claimed to find positive electrical changes in the heart when it is inhibited by stimulation of the vagus nerve, but the interpretation of the results is not clear and the case is a special one.

Turning now to the more grateful task of summarising the chief positive results · there is clearly a fundamental similarity between the processes of excitation and conduction in plant and animal, but certain interesting differences The actual contractile process in the plant seems to be different Two main types of movement have been investigated The first is leaf movements, such as those of *Mimosa pudica*, which are compared with the response of skeletal muscle, and the rhythmical movements of *Desmodium gyrans*, which suggest those of heart muscle. The other type is the process of sap propulsion in the stem. As the same tissue is concerned in leaf movement and sap propulsion, it would seem natural to look for a connexion between the two processes ; this possibility the author does not, however, discuss

The leaf movements of *Mimosa* can be studied either in the intact plant or in isolated preparations The tissue is very sensitive to electrical stimulation by single induction shocks Torsion of the stem and other mechanical stimuli are effective, as can be shown by the electrical response Light can act as a stimulus to *Mimosa*, and the plant is more excitable when illuminated, so much so that a cloud passing across the sun will cause a diminished response to electrical stimulation Subliminal stimuli become effective on repetition The contraction occupies about one second after a latent period of one-tenth of a second Relaxation takes several minutes The tissue is refractory after stimulation. It is readily fatigued and shows a ' staircase ' effect with a few successive stimuli.

The character of the phenomena, particularly the slow response, together with sensitivity to electric currents of short duration, does not suggest the behaviour of an isolated muscle or muscle-nerve preparation, but something more like a reflex, where the sensitivity and speed of reaction of the receptor mechanism need not resemble that of the effector mechanism. Comparison with reflex processes in vertebrates cannot be ruled out, but a closer analogy is probably to be found in such a reflex, if it can be so called, as the retraction of the syphons of the clam (*Mya arenaria*) on exposure to light or other stimuli (cf Hecht, *Jour. Gen Physiol.*, vols 1 and 2)

The movement in question consists of contraction of certain cortical cells of the leaf joint. There is a large body of active cells on the lower side the contraction of which generally masks the feebler action of the cells on the upper side ; consequently, the normal movement on stimulation is a fall of the leaf, but under suitable conditions an active erection can be demonstrated The contraction, unlike the animal contractile process, consists of a diminution of volume, whereby sap is squeezed out of the cells. This accounts for the slowness of the relaxation, which is governed by the uptake of sap. With excessive turgor the movement is diminished or even abolished, though the electric response remains (p. 168) In the dark the leaf preparation or plant becomes excessively turgid—' subtonic,' the author calls the condition. In this state the first stimulus applied elicits only a small erectile response ; with successive stimuli the opposite and normal response gradually reasserts itself. The phenomena appear to be sufficiently accounted for if we consider that turgor merely masks the response of the cells, makes them contract isometrically, and affects the cells of the lower side more than those of the upper,

as is indicated by a greater erection than usual With repeated stimulation the turgor is gradually worked off

Sir Jagadis, however, considers (pp 48-56 and 233-237) that the energy of the stimulus has not merely a trigger action but may also contribute to the available potential energy of the tissue, that the 'subtonic' condition is one of lowered potential energy, and that an erectile response involves an increase of potential energy (what if the plant be turned upside down?). Let it suffice to say that the theory, if the reviewer has not misunderstood it, would imply that the mechanism of plant movement is utterly unlike anything found in the animal kingdom.

Experiments are described showing that the effect of many drugs on muscle and on plant response are similar, but the work is of less importance than it might have been had the drugs been more judiciously selected It is not specially interesting to be told that general protoplasmic poisons such as ether or sulphuretted hydrogen depress activity, because one could have predicted as much With such nonspecific agents, quantitative comparison of the susceptibility of different cells would be of interest, but not a merely qualitative comparison Of much greater interest are the few experiments quoted on the action of specific drugs, such as those showing a similar action of muscarine, pilocarpine, and atropine on frog's heart and the movements of *Desmodium* (p 269)

As the contractile process is essentially a reduction in volume of the active cells, the diameter of a leaf stalk or a stem will be slightly diminished on stimulation. This change has been measured by means of a high magnification lever system (Chapters xi and xii) In the leaf stalk of *Mimosa* all the cortical cells appear to be active, consequently the contraction of a single cell can be calculated With maximal stimulation the change in diameter of the cell is 13 per cent, which implies a volume change of about 35 per cent if contraction is uniform in all directions. The method of measuring the change in diameter on stimulation enables the activity of many plants which make no obvious movements to be investigated A contractile process can be demonstrated in many common plants, such as the bean and *Impatiens* The recorded movements are small and slow, and the latent period is long, but the difference between 'active' and 'inactive' plants is clearly a matter of degree The inactive plant contains fewer or less developed contractile cells, but some active cells have been shown to be present in many herbaceous plants and shrubs. This is not surprising if we accept the author's further contention that sap propulsion is due to a contractile mechanism in the cortex. If the excitation process spreads along a stem, the effect of successive contraction of cortical cells is bound to be a forward movement of sap, if a considerable number of cells in one region can be excited simultaneously and they are predominantly on one side of the structure, the effect will be a movement of the structure as a whole

Sir Jagadis Bose argues convincingly against the view that the ascent of sap is due solely to the action of the roots and leaves, while the rest of the plant is passive and is only a system of tubes. By several different experimental methods he shows that there is a flow of sap in isolated stems and an active process in the cortex (Chapters xxii-xxix) It is possible to object to his use of the term 'peristalsis' for the sap-pumping process, as the analogy has not been demonstrated except in a vague way, but the objection is of no great moment. Propulsion of sap is found to be a normal response to stimulation The direction of flow is always from an excited region to an unexcited region, but the pressure produced by propagation of the excited state in the normal direction is about four times as great as that produced in the opposite direction. The active tissue is identified as cortical by exploring with a needle electrode until the place of maximum electric response is found

Something ought to be said of the performance of *Desmodium gyrans*, the telegraph plant (Chapter xix) Under normal stimulation by light, the leaflets keep up a rhythmic movement with a period of two minutes or so In the dark these 'spontaneous' movements cease after a time, but the plant can be excited electrically or by a light With a weak stimulus it will give a single response, with stronger stimulation a series Apparently other plants will give several responses with moderately strong stimuli, but *Desmodium* is more excitable, less readily fatigued, and shows this phenomenon of 'after discharge' in a far more striking manner. It is remarkable to find still another character of the motor response of plants suggestive of reflex movement in animals

For the investigation of processes of excitation and conduction, and of some peculiar types of contractile process, the vegetable kingdom evidently offers very great scope All those interested in these aspects of general physiology will be grateful to Sir Jagadis Bose for his pioneer work, and for the extraordinarily ingenious methods he has devised A D RITCHIE.

Kinetic Theory and Electric Conduction through Gases.

Conduction of Electricity through Gases. By Sir J J Thomson and Prof. G. P Thomson Third edition Vol I . *General Properties of Ions; Ionization by Heat and Light* Pp. vi+491. (Cambridge At the University Press, 1928) 25*s* net

THE Geissler tubes and Crookes tubes that were in almost every physical laboratory at the end of the last century enabled any student to observe with ease the fascinating phenomena of electric discharges in gases at low pressures These and the newly familiar phenomena of radioactivity and X-rays made the theory of electric conduction through gases appear to be of bewildering complexity

One of the most remarkable chapters in scientific history is that of the development of our knowledge of these phenomena. Perhaps the greatest single factor responsible for the rapidity of the progress was the publication in 1903 and 1906 of the first and second editions of Sir J J Thomson's book The world-wide interest thus aroused by these discoveries, which had originated so largely in the Cavendish Laboratory, has had a profound effect on almost every branch of modern physics

The great influence of the book was due, not so much to the importance of the discoveries which it described, as to the fact that it was in itself a new scientific contribution The results of previously published investigations were discussed in a most critical, but constructive, manner, frequently new points of view were developed and new or improved methods of experimental investigation were suggested. For example, on p. 222 of the second edition, in proposing a method for determining e/m, differential equations were derived which were applicable to the potential distribution in a pure electron discharge in high vacuum When in 1912 the experimental conditions for obtaining pure electron discharges limited by space charge were found, it was only necessary to perform one more integration of Thomson's equation and introduce the boundary condition $dv/dx=0$ at the cathode to derive an equation for the relation between current and voltage in devices having discharges of this character

The spirit in which the book was written is best illustrated by the first and third paragraphs of the preface to the first edition

"I have endeavoured in this work to develop the view that the conduction of electricity through gases is due to the presence in the gas of small particles charged with electricity, called ions, which under the influence of electric forces move from one part of the gas to another. My object has been to show how the various phenomena exhibited when electricity passes through gases can be co-ordinated by this conception rather than to attempt to give a complete account of the very numerous investigations which have been made on the electrical properties of gases. I have, therefore, confined myself for the most part to those phenomena which furnish results sufficiently precise to serve as a test of the truth of this theory

"With the discovery and study of Cathode rays, Rontgen rays, and Radio-activity, a new era has begun in physics, in which the electrical properties of gases have played and will play a most important part; the bearing of these discoveries on the problems of the Constitution of Matter and the Nature of Electricity is in most intimate connection with the view we take of the processes which go on when electricity passes through a gas."

The methods of analysis which were used in the book are essentially a development of the classical methods that Maxwell employed in his development of the kinetic theory

In the twenty-two years that have elapsed since the publication of the second edition, our knowledge in this field has been increasing at an ever-accelerating pace Furthermore, industrial applications of the utmost importance, especially in telephony and radio communication, have been built upon the foundations laid by Thomson New and even more important applications are almost within sight

The advent of the third edition of this book must thus arouse extreme interest It is not surprising that there are now to be two volumes The preface by Sir J J. Thomson says. "The preparation of this Edition was commenced some fifteen years ago and some of it was in type when the War broke out . . . The publication of this Edition is due to my having had the co-operation of my son, Professor G P Thomson, who has done most of the work required for its preparation"

The spirit and plan of the new edition are essentially the same as those of the earlier ones, even the numbering of the paragraphs is the same. The preface says.

"We have adopted a decimal notation for numbering the paragraphs, those that were in the Second Edition are denoted by integers, and those dealing with subjects cognate to the original paragraph by this integer followed by a decimal Most, though not all, of the original paragraphs have been retained, a few in shortened form Otherwise little alteration has been made in them beyond replacing the values of the fundamental constants by the more accurate ones obtained since the publication of the earlier editions."

The nomenclature has been changed to accord with modern practice, using 'electron' in place of 'corpuscle' or 'negative ion,' and 'X-rays' instead of 'Röntgen rays'

The new volume, in 482 pages, covers the ground of the first ten chapters of the second edition, which there required 290 pages The material of about 240 pages out of these 290 is used in the new edition with only minor changes. Thus about one-half of the new volume is wholly new material It has naturally been possible to cover adequately the work of the last twenty-two years only by restricting the subject matter rather closely to the title "Conduction of Electricity through Gases" instead of dealing with the broader field of electric discharges in gases

In Chapter i, dealing with the conductivity of gases in a normal state, five pages are added covering recent research on the penetrating radiation "coming from the sky" In speaking of the uncertain origin of these radiations it is stated (p 12) "It would be one of the romances of science if these obscure and prosaic minute leakages of electricity from well-insulated bodies should be the means by which the most fundamental problems in the evolution of the cosmos had to be investigated"

The subject of the mobility of ions, which occupied 38 pages, or about half of Chapter ii in the second edition, is now treated in a separate chapter of 108 pages. Eleven methods, including the recent ones of Tyndall and Grindley, and of Laporte, are discussed at length, and there follows an excellent treatment of the theory of mobility and its dependence on pressure, temperature, impurities, and the sizes and masses of the ions.

Ten pages are devoted in Chapter vi to an account of Thomson's early work on positive ray analysis, followed by 14 pages on Aston's further development of the mass spectrograph and a discussion of isotopes. In Chapters vii. and viii, ten pages are given to Millikan's determination of e and five pages to C T. R. Wilson's cloud tracks of ions

Chapter ix., on ionisation by incandescent solids, has been increased from 40 to 61 pages, much less than might seem warranted by the great development in this field. After dealing with the effect of space charge on pure electron currents in high vacuum, there follows on p 374 a discussion of the effects to be attributed to the initial velocities of the electrons from the cathode This is treated as a problem of the diffusion of the electrons. It seems to the reviewer that the concept of diffusion of electrons in high vacuum (such as that for which the 3/2 power law applies) is not appropriate in this case, and that the only proper treatment is one of the type that has been given by Epstein, Laue, Fry, and the reviewer in various publications on this subject

As the plan of the book is an application of the classical kinetic theory to the phenomena of gaseous conduction, it is natural that no attempt is made to treat the collisions of electrons with atoms or ions from the point of view of the quantum theory. Critical potentials are mentioned practically only on p. 472 in a comparison of Townsend's data on ionising potentials with those obtained by the Frank and Hertz method Quanta are mentioned only in connexion with photoelectric effects involving the Einstein equation On pp 57-59, a theory is derived for the energy which an electron loses in colliding with a molecule, based upon the classical assumption that an electron in the molecule has a definite period of vibration, so that the impinging electron transfers a variable amount of energy to the vibrating electron.

The present value of the classical methods is, however, in general amply demonstrated by this book, and by the numerous cases where the more rigorous methods of the new mechanics have not yet been or cannot yet be applied to the solution of practical problems. The book is to be thoroughly recommended not only to those interested in the historical development and the present status of the subject matter, but also to those who still desire to have 'physical pictures' to aid them in understanding phenomena IRVING LANGMUIR

Our Bookshelf.

An Introduction to Organic Chemistry By Prof. Alexander Lowy and Dr. Benjamin Harrow. Second edition Pp. xiv+407 (New York. John Wiley and Sons, Inc.; London · Chapman and Hall, Ltd) 15*s*. net.

THE second edition preserves the general character of the original. Although not sufficiently didactic for use as a vade-mecum for junior students of organic chemistry, it should be of value as a supplement to lecture courses and experimental work. Some of the numerous tables and summaries are possibly overburdened with detail, while in other instances the treatment is unduly laconic For example, the isomerism of maleic and fumaric acids is indicated by means of two formulæ with a footnote. "It is suggested that the instructor show this type of isomerism with the Kekulé [*sic*] models." An exposition of spatial isomerism, even with the aid of an instructor and Kekulé models, leaves something to be desired.

Although the carbohydrate chapter has been revised and enlarged, there is no reference to the δ-oxide formula for glucose, moreover, the repre-

sentation of lactose with a formal aldehyde group is somewhat misleading. The book contains a number of useful indications of the connexion between organic chemistry and medicine, pharmacy, dentistry, agriculture, and the biological sciences. There is adequate mention of up-to-date methods of preparing various organic substances in common use, but it is surprising to find, in a modern text-book, the terms 'diatomic,' 'triatomic,' and 'polyatomic' applied to alcohols The type and paper are of excellent quality, the portraits of eminent organic chemists, however, are not well reproduced J. R

Laboratory Methods of Inorganic Chemistry. By Heinrich Biltz and Wilhelm Biltz Authorised translation by William T Hall and Arthur A Blanchard Second edition Pp. xv + 261 (New York John Wiley and Sons, Inc; London Chapman and Hall, Ltd, 1928.) 12*s* 6*d* net.

THE first edition of Biltz was very favourably received, and the present edition is an improvement on the previous one New preparations have been added and the older ones revised The short theoretical sections are also very good, especially that on the periodic system, in which atomic structure is included In most undergraduate courses the amount of practical inorganic chemistry, apart from qualitative analysis, is usually much too small in comparison with the practical organic chemistry, and there is sometimes a danger that the course will lack balance and become one-sided Any idea that inorganic preparations do not offer so much scope for manipulative skill as those in organic chemistry will quickly be dispelled by looking through the present volume, in which a number of more difficult preparations are included. These are in many cases suitable for students who have completed an ordinary course and wish to do more advanced work without actually embarking on research

The book will also be found most useful by students beginning research in inorganic chemistry, and by teachers who wish to introduce inorganic preparations into the more advanced courses It may be recommended to all these as the only work of its standard in existence When the large amount of material presented is taken into consideration, the price is very reasonable indeed.

Che cos' è l' elettricità? Per Giovanni Giorgi. (Collezione Omnia, 8.) Pp. 136. (Roma: Paolo Cremonese, 1928.) 6·50 lire

THE latest developments of physical theories point not only to the possibility of a complete change in our conception of the nature of matter, but also in our views of causality and natural law. They are no longer purely mathematical and experimental Speculations are being made in regions formerly regarded as metaphysical and outside the limitations of human knowledge. No one can say where these speculations will lead us. Recent theories, however, are becoming more acceptable to the average physicist. Electrons and protons appearing as energy centres in so-called material waves remind us of the vortex rings which were much studied fifty years ago

G. Giorgi, in this interesting little book, gives us a clear résumé of the opinions held as to the nature of the phenomena of electricity, beginning with Du Fay in 1733, and ending with de Broglie, Schrodinger, Dirac, and Heisenberg. Practically no knowledge of mathematics is assumed, so this book will be appreciated by the layman as well as by the scientific worker. No one can claim to have a general knowledge of science who is ignorant of these theories. If they are as important as many physicists believe them to be, then the sooner they come up before the general tribunal of mankind the better

Leaf-Mining Insects By James G Needham, Stuart W Frost, and Beatrice H. Tothill Pp viii + 351 + 5 plates (London Baillière, Tindall and Cox, 1928) 27*s* net.

THE authors mention that the object of this book is to provide a non-technical introduction to leaf-mining insects, an account of their biology and lists of miners, together with their host-plants Four orders of insects, namely, Coleoptera, Lepidoptera, Hymenoptera, and Diptera, include species which have developed leaf-mining habits in their larval stages This type of behaviour attains its greatest development in Lepidoptera, and about one-half of the volume is consequently devoted to these insects The various grades of mining habits are discussed, and the correlation between structure and function clearly stressed in different types of larvæ Although the subject is a specialised one, the knowledge brought together by the authors shows that the study of leaf-miners offers many features of interest to the ecologist and to the student of adaptation At the same time, the field naturalist and economic entomologist will find the book of material help in the identification of the species found, more especially in North America. The subject matter is well arranged, the illustrations are for the most part adequate, and there is a useful bibliography provided at the end We can recommend the book as a useful introductory manual

The Cellulose Lacquers. a Practical Handbook on their Manufacture. By Dr Stanley Smith. Pp ix + 145 (London: Sir Isaac Pitman and Sons, Ltd, 1928) 7*s* 6*d*. net.

THE cellulose lacquer industry is one of great importance, and the manufacture and applications of these materials are advancing at a rapid rate. The present manual is written from the practical point of view. The style is often rather discursive, and although the author remarks that he will avoid technical terms so far as possible, this is no reason why he should not spell correctly those which he uses; 'phthallate' occurs several times. The account covers the whole subject, including raw materials, formulæ, plant, pigments, methods of application, and the industrial applications. The book is well printed and illustrated, and it will be found useful to those actually engaged in the industry.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

A Proposed Modification of Einstein's Field-Theory.

IN previous issues of NATURE [1] mention has been made of Einstein's recent field-theory, intended to combine in a compact geometrical model the mathematical representation both of gravitation and of electromagnetism.

The original essay of Einstein is based upon a special covariant derivation and absolute parallelism (already introduced by Prof. Weitzenbock and, independently, by Prof. Vitali), and leads to the construction of two sets of relations, one of which corresponds exactly to Maxwell's theory, whilst the other reproduces the celebrated Einstein's gravitational equations, though only to a first approximation.

I have remarked that Einstein's model may be more completely and satisfactorily attained without abandoning the usual lines of absolute calculus, and, above all, rigorously accounting for both Einstein's and Maxwell's equations. A full exposition of this method with correlated mathematical developments is now in print in the Berliner *Sitzungsberichte* (by the kind transmission of Prof. Einstein). I take the liberty of resuming here my improvement, Einstein's procedure itself having been outlined some weeks ago in the article by Prof. Eddington already quoted.

The support of the model is still the space-time V_4, that is, a Riemannian four-dimensional manifold which embodies space and time; but something is to be added to the topological attributes of this fourfold continuum, and to the expression of its metrics

$$ds^2 = g_{\mu\nu} dx^\mu dx^\nu \tag{1}$$

in general co-ordinates x^0, x^1, x^2, x^3.

To obtain a convenient filling we first recall some fundamental notions of differential geometry. A direction function of the point (x^0, x^1, x^2, x^3) may be defined by means of the corresponding parameters $\lambda^\nu (\nu = 0, 1, 2, 3)$, that is, four numbers which are proportional to the increments dx^ν of the x^ν in the given direction, the factor of proportionality being fixed (if we exclude the directions of zero-interval along which $g_{\mu\nu} dx^\mu dx^\nu = 0$) by the quadratic condition

$$g_{\mu\nu} \lambda^\mu \lambda^\nu = 1\ [2] \tag{2}$$

The differential equations

$$\frac{dx^0}{\lambda^0} = \frac{dx^1}{\lambda^1} = \frac{dx^2}{\lambda^2} = \frac{dx^3}{\lambda^3}$$

define a family of lines, called congruence, such that a line of the family passes through every point of the V_4 in the direction.

Now we may provide our V_4 with a fourfold diagram, *world-lattice*, by introducing not only one only, but also a set of four congruences which intersect each other at right angles. If their parameters are denoted by $\lambda_i{}^\nu$ (i order-suffix, ranging from 0 to 3), we must have, combining (2) with the condition of perpendicularity,

$$g_{\mu\nu} \lambda_i{}^\mu \lambda_k{}^\nu = \delta_{ik} \qquad (i, k = 0, 1, 2, 3), \tag{3}$$

where δ_{ik} has the usual meaning (0 if $i \neq k$, and 1 if $i = k$).

When the $g_{\mu\nu}$ are given, equations (3) represent $4 \cdot 5/2 = 10$ conditions to be satisfied by the 16 parameters $\lambda_i{}^\nu$. But, as the $g_{\mu\nu}$ are exactly as many as the equations (3), we may also regard (3) as the definition of the $g_{\mu\nu}$, that is, of the metrics of V_4, the 16 quantities $\lambda_i{}^\nu$ being taken at will, with the only restriction that the determinant $\|\lambda_i{}^\nu\|$ does not vanish. It is, moreover, very easy to solve explicitly the (linear) equations (3) with respect to the $g_{\mu\nu}$. Denoting by $\lambda_{i/\nu}$ the reciprocal element of $\lambda_i{}^\nu$ in the determinant $\|\lambda_i{}^\nu\|$ (that is, the algebraic complement, or minor, of $\lambda_i{}^\nu$, divided by the determinant itself), we have

$$g_{\mu\nu} = \sum_0 {}_i \lambda_{i/\mu} \lambda_{i/\nu} \tag{3'}$$

Our task is to show that the 16 quantities $\lambda_i{}^\nu$ (and, with them, all the features of world-lattice) may be determined by means of the field-equations. From a mere formal point of view such a requirement is quite allowable. Indeed, the gravitational equations are in number *ten* (as many as the $g_{\mu\nu}$). On the other hand, Maxwell's system involves (besides the $g_{\mu\nu}$) the six elements $F_{\mu\nu}$ of an anti-symmetrical tensor, which define simultaneously the electric and the magnetic force. The system is formed by eight equations, bounded, however, by two differential identities, so that only *six* are independent; and effectively they are able, as is well known, to determine the $F_{\mu\nu}$ uniquely from their initial values. As $10 + 6 = 16$, we have exactly as many equations as there are $\lambda_i{}^\nu$. But in what sense and manner do these equations contain our $\lambda_i{}^\nu$ (and no other unknown quantity)?

The answer is obvious, or even forced, in regard to the gravitational equations, for they are essentially partial differential equations of the second order in the $g_{\mu\nu}$, hence, by (3'), we may regard them as well as 10 differential equations for the $\lambda_i{}^\nu$, which contain, moreover, like the Maxwellian equations, the six components $F_{\mu\nu}$. In order to get relations involving only the geometrical quantities $\lambda_i{}^\nu$, we must connect in some way the F's with the λ. From an abstract point of view this may be done arbitrarily, with the only condition that the six new equations, thus arising from the Maxwellian ones, are independent one of another, and, together, of the ten former, which implies, among other things, that the $F_{\mu\nu}$ cannot be combinations of the $g_{\mu\nu}$ alone.

I propose to put

$$F_{\mu\nu} \lambda_i{}^\mu \lambda_k{}^\nu = \upsilon \sum_0^3 {}_l \frac{d\gamma_{ikl}}{ds_l}, \tag{P}$$

where υ denotes a constant, $\dfrac{d}{ds_l}$ the operator $\sum_0^3 {}_\nu \lambda_l{}^\nu \dfrac{\partial}{\partial x^\nu}$, and the γ_{ikl} are the *Ricci's coefficients of rotation* of the set of congruences to be determined. Their explicit expressions are well known, at any rate it may be remembered that they follow immediately from the equations

$$\gamma_{lik} - \gamma_{lki} = \sum_0^3 {}_\nu \lambda_{l\,\nu} \left(\frac{d\lambda_k{}^\nu}{ds_i} - \frac{d\lambda_i{}^\nu}{ds_k} \right), \tag{4}$$

$$\gamma_{ikl} + \gamma_{kil} = 0 \qquad (i, k, l = 0, 1, 2, 3) \tag{5}$$

I shall not enter into details concerning the features of the position (P) itself, or of its consequences as transformer of the Maxwellian equations in pure geometrical ones. I content myself with a hint to the limiting case of empty space.

It has been a starting-point in the original discovery of Einstein's gravitational equations (and was after-

[1] Compare especially the brief but striking account by Prof. Eddington in NATURE of Feb. 23, pp. 280-281, and the letter from Messrs. Wiener and Vallarta in the issue of Mar. 2, p. 317.

[2] Since the ds^2 of general relativity is indefinite, the condition (2) may very well introduce imaginary λ's. We allow them here for brevity, but in my paper it is shown how any appearance of imaginaries may be avoided in the very appropriate manner systematically worked out by Prof. Eisenhart in his "Riemannian Geometry" (Princeton University Press, 1926).

wards mathematically proved by Serini) that, if the energy-tensor is zero throughout all space, and singularities are excluded, this is necessarily Euclidean. Now what will be the set of congruences in such an empty space, that is, a space where not only material masses, but also electromagnetic forces are absent ?

Our position (P), for $F_{\mu\nu}=0$, leads almost immediately to the conclusion that, *in empty space, the world-lattice is Cartesian.* Any intervention of material or electric phenomena carries, on the contrary, some distortion of world-lattice with it.

T LEVI-CIVITA

University of Rome,
Mar. 18

The Primary Process in the Formation of the Latent Photographic Image [1]

IN two brief notes to NATURE (**120**, 441, 1927 **121**, 865 , 1928), it was shown by one of us that the mechanism taking place during the formation of the latent photographic image in silver bromide emulsions must be closely connected with that causing the photo-conductivity effect (that is, the decrease of resistance on illumination) in silver bromide prepared free from gelatin and other substances present in commercial emulsions.

The complete building up of the latent image is now generally considered as divisible into two stages : (1) The absorption of light by silver bromide and the immediate resulting mechanism, and (2) complicated chemical reactions between the product of the light action and the other substances, such as gelatin, present in the emulsion. The first of these stages consists in the decomposition of silver bromide into silver and bromine and is known as the *primary process*, whilst the latter or *secondary process* is supposed to be concerned with the removal of the bromine (thus leaving metallic silver) due to its taking part in the chemical reactions which follow the primary process The problems arising in this secondary process appear only to be open to attack by chemical methods, but the first is susceptible to physical methods of attack

In the light of modern knowledge, the function of the light in decomposing silver bromide is to transfer the valency electron back from the bromine to the silver ; *during its passage it is momentarily a free electron.*

If, when light shines on silver bromide, there is no escape for the bromine set free (this condition holds when silver bromide is fused between quartz plates), then no permanent change in the substance can take place, and whatever exposure the salt may be given it will be in precisely the same state after the exposure as it was before. But even if there is no actual decomposition, the mechanism of transfer of valency electrons still takes place when the silver bromide is exposed, only in this case there is an equilibrium existing between the rate of their liberation from the bromine ions and the rate at which they go back again. It is these liberated valency electrons which cause the photo-conductivity effect

Thus the photo-conductivity effect in layers of silver bromide made under conditions such that the bromine cannot escape is simply an expression of the primary photographic process, isolated completely from all secondary chemical processes Since the primary process is the part chiefly concerned with the absorption of light, this explains completely why the spectral sensitivity of the photo-conductivity effect in silver bromide is so similar to that of the finished silver bromide emulsion, as the previous communication showed

If these photo-currents are simply due to the liberation of valency electrons, as in the photographic process, then, since we know that the latter can occur in an extremely short time, it is to be expected that these currents will start to flow almost instantaneously with the illumination of the silver bromide.

If a melt of fused silver bromide containing electrodes connected in circuit with a source of E M F. and a current-measuring instrument be illuminated, very complicated effects will in general be observed ; indeed, sometimes a strong *negative* effect (*i.e* decrease of current on illumination) is the result. The causes of these complications cannot be discussed here, but one of the chief difficulties, now overcome, has been to isolate the almost instantaneous electron liberation from all complications, such, for example,

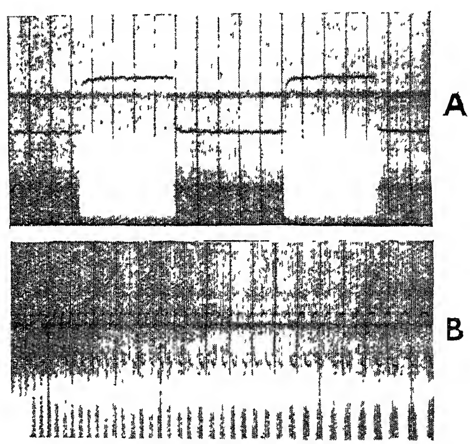

FIG 1 —A Two exposures, one of 0 46 sec and the other of 0 45 sec B A succession of exposures from 0 02 sec on the left to 0 06 sec on the right, the dark vertical lines are 0 1 sec apart and the fine lines 0 01 sec apart

as those which occur at the electrodes. The latter may be eliminated by using silver electrodes and shielding them from the light

A word of explanation is necessary in connexion with the accompanying photographs (Fig 1), the object of which is to show how nearly instantaneous is the photo-current, due to liberated valency electrons, when isolated from all other effects. A source of light was arranged so that a beam passed through a thin layer of silver bromide fused in between quartz plates and then fell on one half of a slit, behind which was a moving kinematograph film. Electrodes in the solidified layer of bromide were connected to a valve amplifier which magnified the photo-current about one hundred thousand times, and was connected to an Einthoven string galvanometer. The image of the string was focused on the other half of the moving film, along which timing marks were produced at intervals of 0 01 second. Thus the moment of illumination of the silver bromide was registered by the photographic impression on one half of the film (the lower half in the figures), whilst the time of appearance of the photo-current as given by the galvanometer deflection could be read off from the other half.

The film shows that the photo-current starts within about 0 001 second of the illumination and is completely established within 0 03 second. Since this is approximately the lag of the galvanometer in the

[1] Communication No 72 from the British Photographic Research Association Laboratories

valve circuit used, the probability is that the effect reaches its final value very much quicker than this, and there seems no reason to doubt that it *starts* instantaneously with the illumination as in the true photoelectric effect.

Incidentally, the film is an illustration of a single beam of light producing *only* the primary part of the photographic process in one layer of silver bromide and the *whole* photographic process (primary + secondary, giving latent image) in another layer, *i.e.* in the emulsion on the film.

We have further observed these photo-currents with an intensity of ultra-violet light which was so small that it only just produced a developable effect on a plate of H and D speed 550 in 1/25 second, *i.e.* the effect is observable in the region of normal photographic intensities.

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Electron Reflection from Cobalt, and Electron Waves.

MEASUREMENTS by a number of observers of the velocity distribution of the electrons leaving the surface of a metal under bombardment by a beam of electrons of known velocity, have shown that a part of the secondary electrons have the primary velocity, the rest having, in general, a lower velocity. No attempt appears to have been made to resolve the secondary emission into its two components when the secondary emission is studied as a function of the velocity of the primary electrons This is a preliminary account of the results of such an experiment Previous work (Davis, *Proc. Nat. Acad. Am*, **14**, p. 460; 1928) has shown that the total secondary emission from cobalt, when plotted against the primary velocity, exhibits a number of sharp maxima and minima extending over an unusually large range of voltages This fact made it seem an ideal subject for the present type of investigation.

The procedure was to measure the total secondary emission (including both groups of secondaries) and then to apply such a retarding potential that only those electrons having within a few volts of the energy of the primary electrons could reach the collector. The difference between the two values so obtained for each primary velocity should give the magnitude of the group having the lower range of velocities The results of the experiment are shown in Fig 1. Here the ratio of secondary to primary currents as ordinates is plotted against the observed accelerating potentials. Curve *A* shows the total secondary emission. Curve *B* represents the 'reflected' electrons (those electrons leaving the target with velocities within two equivalent volts of the primary velocity), and curve *C*, the difference between corresponding ordinates of *A* and *B*, shows the behaviour of the low velocity group. It appears that, for cobalt at least, the important maxima of the total secondary emission curve may be attributed to the 'reflected' electrons.

The critical dependence of the number of 'reflected' electrons upon the primary velocity provokes speculation as to the nature of the phenomenon. A number of unsuccessful attempts to connect the maxima in secondary emission curves with atomic characteristics having been made in the past, it seems possible that a more fruitful line of reasoning might be one analogous to that used so successfully by Davisson and Germer (*Phys. Rev.*, **30**, 705, 1928) in explaining the reflection of electrons at the face of a single crystal of nickel. The observations being reported on were made with a polycrystalline cobalt target rather than a single crystal. Hence electrons might be expected to suffer diffraction at its surface in a manner similar to the diffraction of X-rays in the so-called 'powder' method In this case the Bragg formula

$$n\lambda = 2d \cos \theta$$

should be satisfied, where n is the order of the diffraction beam, λ the de Broglie wave-length

$$\left[\lambda = \frac{h}{mv} = \left(\frac{150}{V}\right)^{\frac{1}{2}}\right]$$

of the electrons, d the spacing of the diffracting planes, 2θ the angle between incident and diffracted beam, and V the velocity of the incident electrons in equivalent volts

The longest wave-length which can be diffracted by a set of planes with a spacing d will be $\lambda_{max} = 2d$. From the geometry of the apparatus it follows that,

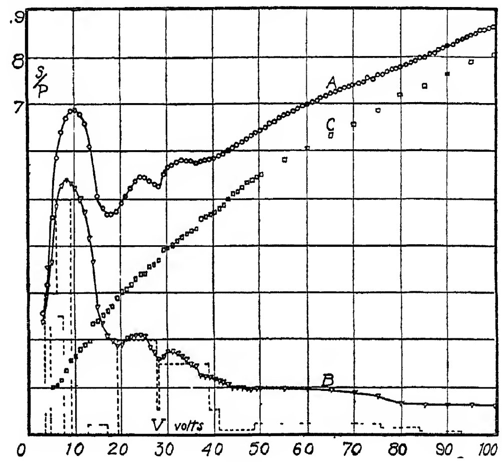

FIG 1

in order to reach the receiver, secondary electrons must leave the target at an angle with the normal not greater than 60°. Applying the Bragg formula within this angular range to the most important sets of planes known for cobalt in the hexagonal close-packed form, it is possible to compute ranges of electron velocities, or bands on the wave-length scale, which should be sent back into the receiving cylinder by constructive reflection. These bands are shown in the figure, their relative intensity having been taken as the known relative intensities of the corresponding X-ray reflections.

It will be seen that by this simple and obviously only approximate procedure, a fair correspondence is obtained between three groups of bands and the most prominent maxima of the secondary-electron curve. The degree of correspondence shown was obtained by shifting the observed curve to the right by a matter of 4 to 5 volts, which is just about the observed thermionic work function of cobalt. It should be pointed out that such a small shift is not in agreement with Davisson and Germer's adjustment of their own observations, they having found that an assumed surface potential of about 18 volts was the most satisfactory.

Bethe has derived approximately the same large value from theoretical considerations. In spite of this difference, it seems worth while directing attention

to what can be done in the way of accounting for secondary electron maxima of cobalt on the basis of electron waves. Attempts to correlate, in a similar way, the maxima observed with other metals are now being made. MYRL N. DAVIS.

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Temperatures of Positive Ions in a Uniformly Ionised Gas.

A GAS through which a current is passing may be considered as a mixture of three gases—neutral molecules, electrons, and positive ions In regions of relatively small field and space charge, each of these gases will show an approximate Maxwellian distribution of energies among the particles, that is, will be in temperature equilibrium within itself, but each gas will have a different temperature Even at gas pressures so high as a millimetre of mercury, and in an almost field-free space, the temperature of the positive ions will be very much higher than the temperature of the neutral molecules with which they are continually colliding The only available source of energy of random motion appears to be the electron gas, which is at a still higher temperature. L H Thomas (*Proc Royal Soc.*, A, **121**, 464; 1928) derives formulæ for the interchange of energy between particles interacting according to the inverse square law and uses them to explain the rapidity with which a Maxwellian distribution of velocities is set up within an electron gas. They may also be used to calculate the temperature of the positive ions from the temperature of electrons and the pressure of the gas in a field-free space.

For comparison with the calculations, data of mine on the width of lines emitted from the negative glow of the helium arc will be used (*Phys Rev.*, **32**, 918, 1928) The following assumptions form the basis of the calculations:

1. The positive ions acquire energy solely from the energy of random motion of the electrons

2 They lose energy by collision with the molecules of neutral helium at a rate which may be calculated from kinetic theory.

The rate at which the positive ions acquire energy from the electrons is calculated from formulæ (4 22) and (4 23) of Thomas's paper, assuming all the electrons to have the most probable velocity and neglecting the velocity of the positive ions. In calculating the loss of energy to the neutral molecules, the latter are taken as stationary and the radius of the ion is taken from the Bohr theory of the helium ion Equating the rate of gain to the rate of loss gives the calculated temperature. As the pressures were very roughly measured and the ion temperatures are subject to considerable uncertainty, the data do not warrant making a more exact calculation The comparison is given in Table I.

TABLE I

Electron Temp (Volts)	Electron Density (Electrons/c c)	Gas Pressure (mm of Mercury)	Ion Temp Calc (Volts)	Ion Temp Obs (Volts)
0 66	$3\ 2\times10^{12}$	1 1	0 12	0 07
0 52	$7\ 5\times10^{11}$	0 5	0 11	0 10
1 2	$2\ 1\times10^{12}$	0 4	0 14	0 14
0 87	$3\ 4\times10^{12}$	0 4	0 22	0 10
0 86	$1\ 8\times10^{12}$	0 25	0 20	0 14

That the calculated values are consistently high may be due to neglecting the shielding effect of the gas on the interaction of the charged particles or to taking too small a radius for the helium ion The agreement is within the error of calculation and measurement. It is interesting that even the order of magnitude is correct, as all direct measurements of interaction between positive ions and gas molecules give values which differ from those calculated from the kinetic theory Harnwell (*Phys Rev*, **31**, 634; 1928), for example, found that the loss of energy of alkali ions of high velocities passing through helium was only a few per cent of that expected Ramsauer and Beeck (*Ann. der Physik*, **87**, 1, 1928) made measurements on the same ions which extended to velocities so low as one volt, and found that the effective radii of interaction were always larger than the predicted radii and increased rapidly as the velocity decreased. The radius of the helium ion is so small compared to the radius of the helium atom that doubling or tripling it would have only a small effect on the calculated temperatures of Table I. Interesting results of the calculation are that the ion temperature should increase with decreasing electron temperature and increase with increasing electron concentration. The range of variation of electron density and temperature in these experiments is too small to test these conclusions.

JANE M DEWEY
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Princeton, N J, April 5

Selenium and Cathode Rays.

IN the course of some experiments upon the light-sensitive properties of selenium, evidence has been obtained by me of what appears to be a direct action of cathode rays upon the grey crystalline form of that substance.

The cell was prepared by condensing vapour of heated selenium upon a gold grid It was placed in a glass tube which could be exhausted and so arranged that a pencil of cathode rays fell upon the crystals after passing through the openings in an earth-connected metal gauze tube which completely surrounded the cell The cell itself was also connected to earth

Precautions were taken to absorb all mercury vapour that might otherwise have diffused from the pump into the exhausted vessel and provision was also made for the elimination of moisture

A simple plan was devised to detect the effect, if any, of the slight luminosity due to fluorescence that appeared when the discharge occurred, and a series of control experiments were made with all conditions similar except that a plain gold grid *without selenium* was placed within the earthed gauze screen.

The anode was sealed into a side tube behind the cathode and at a distance of about one inch from it

It was found that, although the selenium cell used was markedly sensitive to light, no appreciable effect whatever was produced by the slight luminosity of the tube due to fluorescence either of the walls or of the glass strip upon which the selenium was deposited.

When the cell was exposed to cathode rays, however, a rapid diminution of resistance occurred which could be widely varied by deviating the rays with a magnet.

The cell exhibited many of the effects observed when light was shone upon it but the lag was less. Its resistance somewhat increased at first, due to the bombardment, so that the 'dark current' was reduced. This effect was not permanent, but

frequently resulted in an unusual rise of the 'dark current' value after the discharge had ceased.

It is improbable that the marked action of the cathode rays can be attributable to the production of X-rays in the selenium, because in that case the decrease of resistance and recovery would have been far less and taken place much more slowly

Experiments made by enclosing the cell in an earth-connected brass tube provided with an aluminium window 3/1000 inch thick looking towards the cathode, but through which the cathode rays could not penetrate, produced a very slight and gradual decrease of resistance, this and the slow increase on cessation of the discharge are typical of the action of X-rays upon selenium In this case the X-rays were generated at the aluminium window

Under these conditions and with a P.D of 60 volts across the cell, the reading of the microammeter rose slowly 10 microamperes, whereas on replacing the aluminium window by one of metal gauze the deflection suddenly increased to 250 microamperes and fell rapidly, with a slight lag, before returning to the 'dark current' value, when the cathode rays were momentarily allowed to impinge upon the selenium The alternate spark gap at the induction coil was two inches, and the only luminosity appearing in the tube was that due to fluorescence

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April 22

Deposition and Surface Tension.

THE publication of a lengthy study of related phenomena by L. K Luce (*Ann de Phys*, February 1929, pp 167-257) prompted this preliminary report of similar results found by the same as well as other methods during the last two years, under the direction of Prof. Gerlach, in Tubingen.

Iodine deposits resulting from directional molecular rays, as in the Dunoyer experiments (*C R.*, **152**, 592-594; 1911), showed that those of a homogeneous nature are only possible on smooth, clean, perfectly annealed surfaces. On a surface, which was etched, rubbed, or scratched in any particular portion, crystal nuclei started growing immediately. A long series of experiments on glass and silver surfaces of various convex and concave curvatures, showed that deposition and chemical attack are a function of the curvature, cold working; or, in short, a function of the surface tension of the underlying surface Reboul's early work (*C R.*, **155**, p. 1227, 1912, and **156**, p. 1376, 1913) on the chemical attack of silver rods of different curvatures, as well as Luce's later work, give functional curves which are not unlike those obtained in Tubingen

That the factors of adsorption and diffusion play a part in these experiments, as Luce remarks in his work, we find very probable. Adsorption experiments on glass surfaces of known curvature carried out on a long series of glass tubing, and on plane glass of different varieties, show similar functional relations to the results for deposition and reaction. Such thin layers can be weighed with a microbalance. For plane and slightly curved surfaces the sorption layer does not exceed monomolecular thickness, which agrees with the theory of Langmuir (*Zt f. Elektrochemie*, **26**, p. 197, 1920), but with increasing curvature the adsorbed layer increases. In capillaries 0·8 mm. in diameter and less, the adsorbed layer is of the order of seven molecules in thickness. Where chemical attack plays the primary rôle, diffusion is of greater importance Experiments on single crystals of silver are being carried on, and it is hoped that they will throw light on the nature of diffusion.

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Invisible Oxide Films on Metals.

IN his letter in NATURE of April 13, page 569, Dr F. H Constable adduces interesting evidence bearing upon the formation of invisible oxide films on copper at room temperatures In fairness to Dr W. H. J Vernon, whose researches in this field are not mentioned by Dr Constable, it should be stated that, working in my laboratories under the auspices of the British Non-Ferrous Metals Research Association, he demonstrated the formation of invisible oxide films on copper, and studied their inhibiting effect on tarnishing.

Dr. Vernon's results were communicated to the Atmospheric Corrosion Research Committee in 1923 though they were not published until three years later (*Journal of the Chemical Society*, p 2273, 1926) Invisible protective films were obtained by exposure to air at room temperatures, while at higher temperatures (from 50° C. upwards) certain quantitative relationships were established A critical thickness of film was recognised, *within the invisible range*, below which protection was no longer afforded, it was concluded that this corresponded with the unit lattice of cuprous oxide. Later (*Transactions of the Faraday Society*, **23**, 113, 1927) it was shown by the same worker that under favourable conditions, invisible protective oxide films are also produced at room temperatures upon lead and iron

It is interesting to note that some of Dr. Vernon's earlier conclusions are confirmed by the spectrophotometric methods employed by Dr Constable. Moreover, it is satisfactory that there is now general agreement as to the part played by the direct oxidation of metals at ordinary temperatures, about which only a few years ago differences of opinion existed.

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Skull Thickness.

WITH reference to Mr Wilfred Trotter's paper, published in NATURE of April 6, the following quotations from Herodotus (Isaac Taylor's translation) may be of interest.

" A remarkable Fact was pointed out to me by the People who live on the Spot where this Battle took Place. The bones of the slain being heaped apart—the Persians lying by themselves as they fell in their Ranks, and the Egyptians separately also,—the skulls of the Persians are so weak, that you may, if you please, break them in, by throwing a Pebble, while those of the Egyptians are so strong, that you scarcely produce a Fracture by dashing a stone at them."—" I observed also a similar appearance on the Field at Papremis, where lay those slain by Inarus, the Lybian, under Achaemenes, son of Darius "

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The Volta Temple at Como.

IN the year 1899 the centenary of the discovery of the voltaic pile was celebrated in Como, Volta's native city, by a joint International Electrical Exhibition and a National Exhibition of Silk Products. On the morning of July 8, fire broke out in the Exhibition, and the buildings and their contents, including the precious collection of Volta relics, were almost entirely destroyed within the short space of forty minutes.

Of the instruments constructed and used by Volta in his epoch-making experiments, only a few damaged fragments were recovered. By a fortunate chance, Volta's documents were not being exhibited, as the Royal Institute of Lombardy had refused to allow them to be sent to Como. The rebuilding of the Exhibition was commenced immediately, and was prosecuted with such vigour that the reopening ceremony took place on Sept. 1, less than two months after the fire.

A few years later the more difficult problem of the restoration of the Volta relics was attacked energetically and, in view of the apparent futility of the attempt, secretly, by one of Como's citizens, Francesco Somaini, with the help of a small band of earnest coadjutors, and in due course was successfully accomplished. No pains were spared and no document or drawing bearing on the subject was left unstudied, so that the resemblance of the reproductions to the original instruments is as close as it is humanly possible to make it. Besides having this work done and bearing the cost thereof, Somaini has, also at his own expense, erected the sumptuous Volta Temple, in which the whole of the relics, including Volta's records, the national edition of Volta's works, etc., are now housed.

This temple was designed by Frigerio, and is situated close to the shore of the lake. It is of incombustible material throughout, and is in the neoclassic style, consisting essentially of a circular court or hall of ceremonies, surmounted by a hemispherical cupola which admits a soft light to the interior. On the roof of the building, at each of the four corners, is a pedestal light faced by a griffin. The main floor of the temple is approached by two wide lateral staircases, and the doorway has on either side, recessed statues representing Faith and Science.

Within, the recesses between the central court and the outer walls of the building contain glazed cases in which are arranged both the fragmentary remains of the instruments rescued from the fire and the reproductions of the originals. The court contains a bust of Volta on a tall column and an ornamental bronze tripod presented by the University of Pavia, where Volta served for several decades as professor and rector.

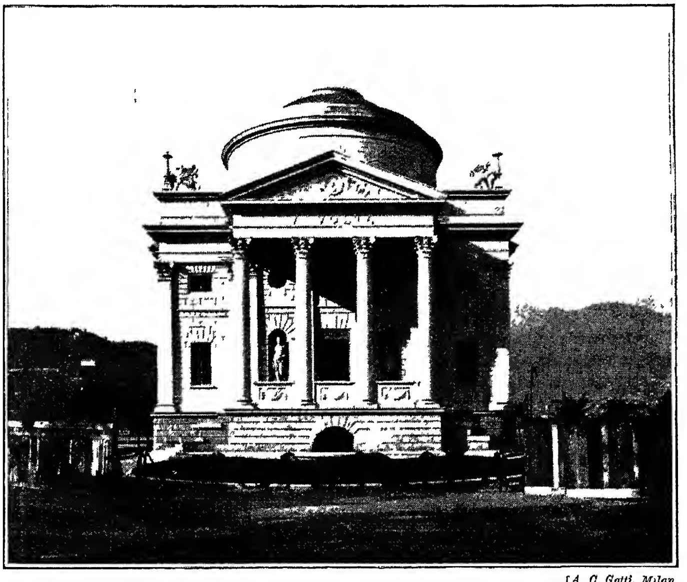

FIG. 1.—The Volta Temple, Como. [A. C. Gatti, Milan.

A marble staircase, to the left of the entrance, leads to a gallery which surrounds the central hall and contains the library, manuscripts (including some which Somaini was fortunate enough to discover at Vienna), medals, minor records, etc. The cupola is supported by four decorated angular pilasters and eight marble columns. On the front of the parapet of the gallery are sixteen plaques giving the most significant dates in Volta's life, and four bas-reliefs representing him teaching at the University of Pavia, demonstrating his pile to Bonaparte at Paris, receiving the Emperor Napoleon in Pavia, and prophesying, as he leaves the church at Lazzate, telephonic communication. The mosaic paving of the circular hall and of the surrounding recesses is ornamented with marble, onyx, and alabaster, and the framework of the glazed cases in which the exhibits are arranged is of iron or bronze coated with green patina so as to resemble ancient bronzes.

The skeleton of the building, including the foundations, is of reinforced concrete, the external ornamentation being chiefly of Aurisina stone and the internal of Musso marble, Viggiù stone, and stucco. The structure measures about 20 metres wide by 25 deep, and the height to the apex of the cupola is more than 21 metres. The building was commenced in November 1925 and was completed by May 1927.

First among the instruments invented by Volta comes the electrophorus (1775), which followed as a natural consequence of the views expressed in his dissertation "De vi attractiva ignis electrici ac phenomenis independentibus," published in 1769. In the three years subsequent to the appearance of the electrophorus, Volta studied, both theoretically and experimentally, the influence of the form on the electrical capacity of a conductor and elaborated the conception of tension or electrical potential These considerations formed the starting-point of a thorough investigation into the action of atmospheric electricity, this leading to the invention of the condenser, which is also numbered among the exhibits While developing his ideas concerning electric meteorology and the origin of atmospheric electricity, Volta devised the very sensitive straw micro-electrometers and the electrostatic balance, reproductions of these being among the apparatus shown The various forms of voltaic pile assembled by the inventor from such ordinary household articles as spoons, and water-vessels from bird-cages, are also included

[A O Gatti, Milan

Fig 2 —Interior of the Volta Temple

The temple has been placed in the charge of Prof Felice Scolari, in conjunction with the Royal Lombardy Institute, and has been generously provided, also by Somaini, with an endowment fund of 500,000 lire, the income from which is to furnish annual prizes of 5000 lire each, to be awarded to distinguished students of Como or of the canton of Ticino desirous of prosecuting studies in electrical subjects.

Physics in Relation to Oil Finding.[1]

By Prof A. O Rankine

EVIDENCE has accumulated during recent years that physical methods can be used under suitable conditions to facilitate the detection and location of minerals buried under the ground This is a fact of considerable economic importance, having regard to the very great and wasteful expense of indiscriminate boring Even the most careful geological survey often fails to fix with sufficient accuracy the points at which drilling is likely to be successful Here, properly applied, physics may make its contribution to enhance the probability of success

We are not now concerned with the divining rod and similar devices—similar, at any rate, in the respect that they can only be operated by persons specially endowed with certain obscure faculties Sometimes the devices are dressed up to have the appearance of physical apparatus, and the methods are called geophysical, but all have this in common —that they are not capable of being independently checked, and for that reason may safely be ruled out of serious consideration. We are dealing with genuine physical methods which depend on the differences of physical properties of underground materials, and produce above the surface reliable indications, the measurement of which may provide valuable information regarding sub-surface structure

It is important to emphasise at the outset that there is no question of physics being employed to the exclusion of geology. At the best the problems to be solved are extremely difficult, and the closest possible co-operation between the two sciences is essential This alliance is implied in the term 'geophysics,' and for the successful development of this as a practical subject, geophysicists adequately trained both in physics and geology are the ideal personnel Physics alone cannot solve problems of underground structure, whatever may be the efficiency of the method employed, for the unknown factors are far too numerous for a unique solution to be possible The geologist must first indicate the kind of underground structure which is sought, and all the probable conditions under the region to be surveyed, before the physicist can even decide whether any available physical method

[1] Substance of two lectures delivered at the Royal Institution on Feb 21 and 28

has a reasonable chance of being applied with success Often, owing either to the absence of surface indications of a geological character, or to such indications being misleading because of 'nonconformability' of superincumbent strata, the geologist is unable to locate with precision the structures he is seeking It is in such circumstances that physics has been able to join forces and help to define underground conditions more exactly

With particular reference to the occurrence of mineral oil, geology provides the information that it is usually associated with salt-domes or anticlines, buried more or less deeply below the earth's surface A typical salt dome, of which there are numerous examples in Texas, is a sort of underground plateau of rock salt, sometimes with a relatively thin covering of anhydrite, called caprock, the whole being below an overburden of sands and clays The superficial area of the roughly circular top of the dome may be several square miles, and its depth may vary from a few hundred to several thousand feet Oil may be located sometimes at the top of the dome, and sometimes at various levels down its flanks The earth's surface above and around the dome is usually very flat, and there is little in the way of reliable geological indications to determine their positions

On the other hand, limestone anticlines, such as occur in south-west Persia, are blunt limestone ridges, perhaps several miles in length and relatively narrow, covered, too, with a thin layer of cap-rock, underlying a mixture of alluvium, sand-stones, marls, gypsum, and salt In the upper part of the anticline, just below the cap-rock, natural gas may be found, farther down the flanks occurs the crude oil with much gas in solution, and still farther down the flanks salt water Unlike the conditions relating to salt-domes, however, surface evidence of folding structure is abundant, the general direction of the strike being unmistakable But, unfortunately, owing apparently to the plasticity of the overburden, these geological indications leave in considerable uncertainty the positions of the summits of the anticlines

Here, then, is the problem of oil finding from the point of view of physics It is to locate, within regions already roughly delimited by geological considerations, the position and extent of salt domes and limestone anticlines Thus the search is not for the oil itself, but for the structures with which it is commonly associated It is true that some claims have been made of locating oil as such by a method depending on its electrical conductivity, but this is very doubtful, and on theoretical grounds the method is distinctly unpromising To find the oil itself is not asked of the geophysicist; if he can locate the salt dome or the anticline with enough precision, it will always be worth while to drill

The physicist thus has to consider what properties of these structures are likely to provide surface indications capable of physical measurement and interpretation Caution is necessary in this respect, having regard to the unfortunate tendency to generalise geophysical methods. These have been enumerated in Prof Eve's interesting article in NATURE last year [2] Although various claims have been made, there exists no convincing evidence that magnetic and electrical surveys have assisted materially in the location of the structures under discussion Moreover, the magnetic susceptibilities and electrical conductivities of salt and limestone differ insufficiently from those of the surrounding materials to give on theoretical grounds any real expectation of successful application The only physical properties which have hitherto without doubt provided means of discrimination are the differences of density and elasticity as between the salt or limestone on one hand, and the superincumbent material on the other

Remarkable success has been achieved by measuring local variations of gravity which depend directly on the differences of density of sub-surface materials The approximate relative densities of salt and clay, for example, are 2 1 and 2 4, and of the cap-rock over a salt dome 2 9 Small though these differences are, the elegant and amazingly sensitive Eotvos torsion balance has been proved capable of measuring the corresponding gravitational effects in the neighbourhood of numerous salt domes in Texas and elsewhere, thereby locating and defining the limits of such domes, some of them deeply buried below the surface For a lucid account of this beautiful instrument the reader may be referred to papers by Capt. Shaw and Mr Lancaster Jones [3]

The main purpose of this article is to give an account of a relatively new and less well-known successful method of locating structures likely to be oil-bearing, known as the seismic method This method can be applied even in rough country, like that in the Persian oil-fields, where gravity measurements are too much distorted by surface effects to give reliable indications of underground conditions It depends not only on the relative densities but also on the relative elasticities of the rocks encountered, or, what amounts to the same thing, the speeds of propagation of longitudinal mechanical disturbances in these media. In the salt dome structures of Texas, these velocities differ considerably, being about 5300 metres per second for the salt, and about 2000 metres per second for the clay and sand overlying the dome. For the limestone structures of Persia the difference is not so marked, the approximate figures being 4700 metres per second in the limestone and 3700 metres per second in the overburden

One may perhaps digress for a moment to consider the possibility of using direct reflection from a clay-salt interface as a means of determining its depth If a device similar to the remarkable depth-sounding machine [4] which has been so successful at sea could be used, the great advantage would accrue that the measurement of the time taken for the sound to go down to the interface and return by normal reflection would enable the local depth to be estimated But the method is not

[2] "Geophysical Prospecting" By Prof A S Eve, NATURE, Mar 10, 1928, vol 121, p 359

[3] *Proc Phys Soc*, vol 35, p 151 and p 204

[4] "The Acoustic Method of Depth Sounding for Navigational Purposes," by the Staff of the Director of Scientific Research, Admiralty, NATURE, Mar 29, 1924, vol 113, p 463.

successful in practice, not because of the failure of the interface to reflect, the reflecting power being reasonably great, but because of the enormous damping of vibrations of audible frequency in the upper layers of the earth Trials with an Admiralty echo-sounding machine have actually been made in Persia, but the sounds from the hammer proved much too feeble to be heard through the ground on the microphone at any useful distance It is significant also of the poor transmitting power of the ground that the explosion of several hundred pounds of gelignite at half a mile distance was not audible through it as a medium, although it could be heard, of course, very loudly through the air

We are thus faced with the position that great disturbances of the earth's surface, conveniently in the nature of explosions, are necessary effectively to penetrate to the depths at which oil-bearing structures are frequently found Also that a seismograph, which will record vibrations of low inaudible frequency, is preferable to the microphone on account of the smaller damping of such vibrations This at once rules out the direct determination of depth, previously suggested, for a sensitive seismograph obviously cannot be operated in the same position as a large explosion which excites the initial disturbance The recording must be done at a ' safe ' distance and the depths of the interface at points other than those immediately below the explosion become involved, thus complicating the problem by the change from one to two dimensions

The necessity for using an explosion involves a new difficulty on account of the appreciable time the consequent disturbance of the earth lasts In all cases the reflected disturbance reaches the seismograph *later* than that travelling direct near the surface, since its path is longer. Moreover, it is usually small in comparison with the direct waves, and the effects of the latter upon the seismograph at practicable distances last considerably longer than the difference of times of transmission Consequently the reflected effect becomes so much obscured by the larger direct effect as to be unrecognisable The solution to this difficulty lies in the existence in practice of another disturbance associated with the lower (higher velocity) medium, but distinct from the reflected disturbance, which may, at a sufficient distance from the explosion, reach the seismograph *first* Although small, its time of arrival can be readily recognised, since it makes its record on the seismograph *before* the latter becomes violently disturbed by the direct waves That is the essence of the success of the seismic method of revealing underground structure

The phenomenon with which we are dealing is the same as that which has recently been recognised as operative in natural earthquakes Even in near earthquakes, where the curvature of the earth plays no important part, the records of seismographs show preliminary displacements which apparently correspond to ' rays ' from the earthquake source which pass from an upper stratum (of low propagation velocity) at the critical angle into a lower stratum (of higher propagation velocity), run parallel to the interface and eventually emerge again at the critical angle to reach the seismograph on the surface This is, of course, an ' optical path ' of an extreme character according to the ordinary laws of refraction, but since the initial incidence is at the critical angle, total reflection would occur according to the same laws, and no energy at all would be associated with the path in question Dr Jeffreys [5] has, however, shown that if the problem be treated as one of diffraction instead of simple refraction, the rather curious result emerges that a finite fraction of the initial energy may be expected to reach the seismograph (as is in fact found in practice) at a time which is the same as that obtained by considering the extreme optical path above described This applies to longitudinal disturbances There are in solids, of course, transverse disturbances as well, but these travel more slowly, and need not concern us here, since, as has been already stressed, the question is one of *first* arrivals

Prof Mintrop was the first to recognise the applicability of this phenomenon to the smaller scale problem of the relatively shallow formations in the earth, using artificial explosions instead of natural earthquakes As a result he has initiated a practical system which has been widely and successfully used to determine the depths of such formations To make the method clear, we may take the simple case of two superposed horizontal strata (Fig 1) in which the velocities of com-

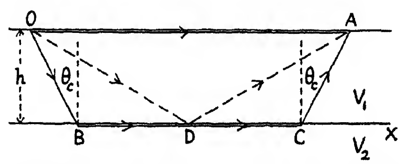

FIG 1.—Explosion at O, seismograph at A, both on the earth's surface. XX is interface between two media of velocities V_1 and V_2, with $V_2 > V_1$

pressional waves are V_1 and V_2, the latter corresponding to the lower medium and being (necessarily) greater than V_1 If an explosion is caused at O and a recording seismograph is located at A, three distinct disturbances reach the seismograph. One goes direct from O to A (We are neglecting here the small curvatures which may arise from gradual variation of velocity with depth.) Another is reflected at D and arrives at A necessarily later than the former, its path being longer The remaining disturbance arrives at A at a time corresponding to the equivalent path $OBCA$, OB and AC each making the critical angle $\theta_c = \sin^{-1} V_1/V_2$ with the normal In the part BC the speed is the higher velocity V_2, and it is evident that if OA is great enough the total time occupied in transmission may be equal to or even less than that for the direct path OA, which is wholly in the lower velocity medium If so, its small effect will be recognisable on the seismogram in spite of the large disturbance which follows afterwards.

(*To be continued*)

[5] " On Compressional Waves in Two Superposed Layers " By Dr. H. Jeffreys, *Proc Camb Phil Soc*, vol 23, p 472, 1926

Centenary of the Zoological Society of London.

THE annual gathering of the Zoological Society of London to receive the Council's report was held on Monday last, April 29, at the meeting room in the Gardens at Regent's Park. The occasion signalised the centenary of establishment of the Society by Royal Charter in 1829. Following this compliance with precedent and duty, a centenary celebration, extended and exceptional in character, took place in the Great Hall of University College, the Duke of Bedford, the Society's president, occupying the chair. In the evening a private complimentary dinner was held elsewhere, at which foreign and official guests were present, including the Prince of Wales.

The Zoological Society itself, as an organised body carrying diverse and onerous responsibilities, has deserved well in endeavour during its centenarian existence; its gardens, moreover, as a prime and essential feature of the original scheme, have long constituted a household word inseparable from national thought and concern. But the story of initiation of effort is somewhat older than the century implied by the charter date, 1829, and is comparable, we think, with the early beginnings of other scientific societies which sprang up at the threshold of the Victorian era. There were influences tending towards corporate association, such as British exploratory activity, the arrival of natural history specimens, and new views attaching to zoological studies. The Linnean Society, instituted in 1788, could not, as time went on, fully satisfy the requirements of zoology. In such circumstances, a group of members of that body conceived the idea, in 1822, of establishing a Zoological Club, the object of which should be "the study of zoology and comparative anatomy in all their branches, and more especially as they relate to the animals indigenous to Great Britain and Ireland." The meetings were held in Soho Square, at the former residence of Sir Joseph Banks (who had died in 1820) and home of the Linnean Society.

The Club accomplished much important work before its dissolution in 1829. Engaged in the advancement and recognition of zoology, the members were mutually cognisant of the outstanding achievements of Sir Stamford Raffles, the distinguished British colonial governor in Eastern lands, and of the unique and extensive zoological collections he had brought together. On returning permanently to England in 1824, Sir Stamford suggested to Sir Humphry Davy, the president of the Royal Society, a plan for the formation of a zoological society which should combine with the pursuit of science the introduction and domestication of such quadrupeds, birds, and fishes as might be most likely to prove useful for agricultural and domestic purposes.

Early in 1825 a circular announcement was made of a proposal to establish a society the object of which would be to attempt the introduction of new races of quadrupeds, birds, or fishes, applicable to purposes of utility, either "in our farm yards, gardens, woods, waters, lakes, or rivers; and to connect with this object a general zoological collection of prepared specimens." The name of Sir Stamford Raffles occurs in this circular, as well as, it is interesting to note, that of the Duke of Bedford. Writing round about this date to his cousin, Sir Stamford says: "I am much interested at present in establishing a grand zoological collection in the metropolis . . . Sir Humphry Davy and myself are the projectors, and while he looks more to the practical and immediate utility to the country gentlemen, my attention is more directed to the scientific department; . . . it is further expected we may go far beyond the Jardin des Plantes at Paris." Here, adverting again to the members of the Zoological Club, it was afterwards (1829) put on record that it was in the impulse originally given by their exertions to the propagation of science, more particularly by laying the foundation of the Zoological Society, that their agency could be traced in principles and objects.

The scheme outlined briefly above, wide in its interests, and to be regulated by laws drawn up with the concurrence of the members, met with a cordial reception, and by this time (1826) Sir Stamford Raffles was an active, and in all probability dominant, personality in the difficult procedure of inauguration. Wisely, the decision was taken to draft a report on the present state and progress of natural history, especially zoology, with an account of the institutions which supplied encouragement on the Continent, and showing the necessity of some similar establishment in Great Britain. Next, application was made to the Commissioners of Woods and Forests for a grant of land from the Crown. Looking back, we may perhaps picture some perturbation of the official mind respecting so novel a proposition. However, all went well, and finally space was allotted in the great demesne of Regent's Park.

The first general meeting of the Society was held on April 29, 1826, when Sir Stamford Raffles was unanimously elected president. He read an introductory address reviewing the position of zoological studies, detailing also the objects and plans of the embryo institution. Soon after, there occurred, on July 5, the death from apoplexy, at the early age of forty-five, of this notable president and man of affairs. Sir Humphry Davy, in offering tribute, said of him that "having lost one splendid collection by fire he instantly commenced the formation of another; and having brought this to Europe, he made it not private, but public property, and placed it entirely at the disposal of a new association for the promotion of zoology, of which he had been chosen president by acclamation." The following year the Marquess of Lansdowne was elected to the presidential chair, retiring in 1831. The fellowship roll comprised then 2000 names. In 1829 the crowning of effort came in the grant of a charter by King George IV.

Through limitations of space we must leave at

this point reference to the activities of the immediately succeeding years as regards both the Gardens and the Society. Some idea, however, of the achievements which had marked the close of the nineteenth century can be formed by a perusal of Mr H Sherren's interesting volume on the Zoological Society

The establishment enjoyed special advantages during the secretaryship of Dr P L Sclater, covering forty-three years. Since then the zealous and enterprising work of Dr. P Chalmers Mitchell has brought the Society to its present distinctive and high position among the zoological societies of the world As regards staff, it is significant that two women now hold office, respectively, as curator of reptiles and curator of insects Recently, the Society has acquired Whipsnade Park, on the borders of the Chilterns, a derelict estate, destined for conversion into a zoological park, open to visitors

News and Views.

British chemical manufacture since 1913 has not only made rapid strides which have brought it into a position of commercial eminence and have kept it abreast of world-wide development, but it has also, at least so far as its leaders are concerned, taken care to consolidate the ground gained and to prepare for further progress by the establishment and endowment of research work. At a public meeting arranged by the British Science Guild at the Mansion House on April 24, an account of which appears elsewhere in this issue, Lord Melchett, Sir Frederick Keeble, Mr. A B. Shearer, and Mr. F. H. Carr showed something of the immensity of the contribution which chemical manufacture is making, especially in Great Britain, to the welfare and prosperity of the people. The attention of the recipients is of course distracted at the moment by discussions and political promises of employment, industrial prosperity, peace, and social service Perhaps it was fortuitous, but more probably inevitable, that the very same phrases were used, not of ideals, but of solid accomplishments, by the speakers The artificial silk industry has already, directly or indirectly, given employment to hundreds of thousands of workers; creating its own demand, it has often brought a touch of colour and beauty where there was little that was not drab and formless, and it has probably not been without influence where of late years a notable increase in self-respect and self-confidence has been apparent The nitrogen industry, in time of war a sharp sword for which the British Empire reached too late, has since been beaten into a ploughshare, which is already firmly harnessed to man's ever-increasing material needs, so that the fear of nitrogen-hunger has been completely dissolved. The drug industry has already been enabled in a multitude of homes to give health where but the spark of life remained, to free the mind from the assaults of the body, and to raise barriers between whole communities and the menace of disease

All this has been made possible by basing commercial acumen and technical skill on a firm foundation of fundamental research. The chemical industry is a structure which must be designed elastically, in order that it may rest securely and continue to grow on a base which is not only continually extending, but also may at times be found deceptive in its appearance, as researchers probe more and more deeply into the origin and meaning of things. It is to the credit of British industry and to that of the State that provision has been made for such investigations to be carried on both in the industrial and in more purely academic laboratories. Scientific research of many kinds is even more than a base, it is a frame whereby existing industries are kept virile and progressive, and around which may be built a new industry. We cannot enter into a discussion regarding the precise relation of our chemical industries to the various articles of political faith, but we can at least point out three ways in which individual or political action can help to maintain our industry and pave the way for further successful advances. We hope that our fellow-citizens will never permit themselves to forget the vital position which modern chemical manufacture occupies, not only in determining the prosperity of nations, but also in alleviating human suffering and in increasing the comforts of life. Further, we hope that they will use their influence, in whatever way seems to them proper and effective, to secure that those industries shall be nurtured in their infancy, fed with men and women of sound training, and encouraged in their growth Finally, although we should not contemplate with equanimity an entire Cabinet of chemists, we hope that the experience and advice of our pioneers in science and the scientific foundation of industry may be given yet greater weight in the counsels of the nation

A large and representative assembly attended the centenary celebration of the Zoological Society, held on Monday last in the Great Hall of University College, London The Duke of Bedford, president of the Society, occupied the chair, supported by members of Council and those who were designated to convey congratulations on behalf of British and foreign countries. In his introductory remarks the president extended grateful thanks to the delegates who had come from many parts of the world to offer good wishes in person, and express their appreciation of the Society's long continuity of effort. Dr P. Chalmers Mitchell, secretary, gave an epitome of the scientific work which had engaged the attention of the Society. He emphasised that the institution was founded by scientific men, and that their aim was not to be merely exhibitors of animals and entertainers of the public. The Society has an obligation to advance zoological studies and is fully mindful of it. In parasitology much has been done of practical importance to men and animals. An interesting summary was given by Dr Mitchell of the work of the prosector's department. Through the publications of the Society a great body

of original research is carried on and encouraged, and he recalled that one of the obligations is the maintenance of a standard library. In physiology, the relations of animals to their environment, or response to different physiological conditions, is receiving attention in the light of modern studies in that field.

SIR CHARLES SHERRINGTON offered felicitations on behalf of the Royal Society, M. Charles Gravier, for the Paris Academy of Sciences, Zoological Society of France, and the Paris Museum of Natural History, Herr H H Dieckhoff (representing the German Ambassador), speaking in excellently phrased English, claimed that Germany has always been happy to assist in the Society's pioneer work, which has brought rich compensations to knowledge. Dr Casey Wood, speaking for the Smithsonian Institution, Washington, referred to a message just to hand from its secretary, Dr C. G Abbott, who, he thought, represented the natural history institutions of his country The message ran "It is my desire to extend to you the greetings and best wishes of our organisation overseas The Smithsonian Institution has had close and pleasant affiliation with the Zoological Society of London. It is my sincere wish that your Society may grow and prosper equally in the coming hundred years as it has in the century that has elapsed." Dr Jordan, Royal Academy of Sciences, Amsterdam, expressed "deep and proud respect" Prof Cossar Ewart and Prof A. F. Dixon, representing respectively Scottish and Irish institutions, offered congratulations. The proceedings, which were worthy of the great Society, closed with a vote of thanks to the Duke of Bedford, proposed by Sir John Bland-Sutton.

AN instructive discussion took place in the House of Lords on April 25 on the proposed large power station in Battersea. The principal objection to this station is the probable large emission of sulphurous fumes from the proposed chimneys, which will be 255 feet high It appears that approximately one-third of the station will replace three existing generating stations, and to this extent only has authorisation to proceed been given at present. The displaced stations are antiquated, and it has been calculated that the completion of this part of the scheme will reduce the present output of sulphurous acid by about 30 per cent We understand that the matter is being carefully considered by the Ministry of Health. Unless the Ministry, the Government Chemist and the Department of Scientific and Industrial Research, say that no danger accrues from this cause, the full scheme is not to be completed Special methods are being tried for cleaning coal so as to reduce its sulphur content. Washing the chimney gases with forced sprays of water is also being tried For large scale research, one of the large London power stations might be employed. Lord Birkenhead pointed out that little had been done in the past to develop the cheap supply of electric power, on which our future commercial prosperity largely depends He said that the arguments brought forward by the opponents of the scheme should have been brought forward two years ago, and that the erection of the new power station would, from the commercial point of view, be a great boon to the residents in Battersea. In our opinion, intensive scientific study should be devoted to the elimination of sulphurous acid from the chimney gases, and electrical engineers would do well to enlist the aid of chemical experts.

SIR HAROLD HARTLEY, who delivered the Theodore William Richards memorial lecture before the Chemical Society on April 25, gave an intimate and inspiring account of the social and scientific life of that great Harvard chemist, former president of the American Chemical Society, Davy and Faraday medallist, and Nobel prizeman, who died on April 2, 1928 He said that in Richards chemistry has lost a great experimenter, the founder of a famous school of research, and one whose methods and example have exerted a profound influence on chemical investigations in every country. His earliest investigation, suggested by Prof Josiah Parsons Cooke of Harvard, under whom he commenced his research career at eighteen years of age, consisted of a re-determination of the atomic ratio hydrogen: oxygen, and involved the weighing of globes of hydrogen, the passage of the gas over cupric oxide, and the weighing of the resulting water. The excellence of the work was recognised by the award of a fellowship which enabled Richards to spend a semester at Gottingen, and to visit most of the important laboratories of Germany, Switzerland, France, and England He always advocated this plan of spending half a year abroad in intensive work in one institution, followed by half a year of peripatetic study, as generally offering the greatest advantage in the time available. In 1901 he received an unusual compliment in the form of a call to a chair at Gottingen, but his services were retained at Harvard, where he remained for the rest of his life The investigation of atomic weights occupied the greater part of Richards's life, their fundamental nature appealing especially to his intense desire to know something more definite about the material and energetic structure of the universe, his first choice was copper, the study of which occupied several years, and was carried out with his typical thoroughness

RICHARDS was responsible for devising the nephelometer as a means of overcoming certain difficulties in atomic weight work which arise from the slight solubility of the silver halides. A second visit to Germany in 1895 gave him a new outlook, and he returned an enthusiastic, if critical, disciple of van 't Hoff and Ostwald All of Richards's early work had been performed under most trying conditions in Boylston Hall, but in 1912 the Wolcott Gibbs memorial laboratory, which in equipment, convenience, freedom from fumes and dirt and from rapid temperature changes probably excels any other research laboratory in the world, was erected. A constant stream of researches on atomic weights came from Harvard, but the solution of the problem of their relationships seemed no nearer Richards expressed his conviction that the periodic system represents only in a very crude fashion relationships which are highly complex and subtle. The answer to the riddle

was, however, provided in 1912 by Russell, Fajans, and Soddy in their conception, independently, of isotopy Richards's interests were not confined to atomic weights, and his activities included investigations on electro-chemistry, thermo-chemistry, and ionic equilibria. Four papers, entitled "The Significance of Changing Atomic Volume," published in 1901–4, outlined the fields of physical chemistry with which he was most closely to be associated for the next twenty-five years Many compressibilities up to 500 atm. were measured from 1904 onwards, and fresh possibilities were opened in 1922 by Bridgman's researches on compressibility up to 12,000 atm , during the last year of Richards's life, much of his time was devoted to the analysis of Bridgman's results and his own earlier work, and the relative magnitudes of the internal pressures are found to correspond satisfactorily with the physical properties of the elements examined A long series of researches in thermo-chemistry originated in his interest in the energy changes and changes in heat capacity accompanying chemical action, and their relation to his theory of compressible atoms He was, in fact, the pioneer of modern precision calorimetry, and his electro-chemical work is a most valuable contribution to our knowledge of amalgams His work, indeed, constitutes a coherent attack on the constants of Nature

THE Annual Report for 1927–28 of the Agricultural Research Council of the Ministry of Agriculture consists of short summaries of the work in progress at the research stations and institutions in Great Britain in receipt of grants It is a lengthy document, full of interest both scientific and practical. A perusal of this document would cause no little surprise to those who are loud in their complaints that the Government does little or nothing to benefit the agricultural industry, and would be enlightening to others who do not realise the extent to which research into the sciences associated with agriculture is assisted by government funds Scientific research, however, is not always popular even among those who will ultimately benefit from it, and unless it can be proved that the results of such work are of immediate service to the farmer, he, at any rate, is apt to be sceptical of its value Criticism of this kind, however, is apt to neglect two important aspects of the problem which become of increasing importance in a country like Great Britain. Under the various conditions of soil and climate, transport and markets, the agricultural industry is not really one, but consists of a large number of concerns differing largely in their needs, and in the character of the problems that beset them, so that results of research of vital importance to one section of farmers may be of little or no interest to others. As time goes on and an ever greater call is made upon the products of the soil, and farming departs more and more from traditional and accepted methods, which were in the main designed to limit risk, and ensure economic stability, so will the industry depend to an increasing extent upon the results of scientific research. It is in these two directions that the contents of this volume are of special interest, dealing as it does with almost all aspects of plants and animals in relation to the soil and to the means of their production.

IT is perhaps invidious to single out the work of any single institution from this interesting account, but the Rothamsted work on the inoculation of lucerne, and that at East Malling on the manuring of apple trees, will appeal with great force to those interested in either of those problems In view of the economic pressure in the farming industry and the reversion of arable land to grass, and the attempts that are being made in the direction of intensive grassland production, the work at Cambridge, Aberystwyth, and Aberdeen will make a wide appeal It is now beginning to be realised that the problems connected with the management of a mixed herbage such as natural and artificial grassland are more difficult of solution than those of a single crop. The work of these centres has made it clear that, given suitable soil and climate, it is possible to produce in grass all types of food for live stock, from that which is little better than straw to that which is more similar in character and composition to linseed cake. It is surely a triumph for scientific work that this should have been possible, and should be a sufficient answer to those, ever decreasing in numbers, who doubt the value of expenditure on research.

A COMMITTEE has recently been formed, with Lord Cottesloe as chairman, with the object of placing a memorial in the Tower of London to the memory of the Rev. Alexander John Forsyth, the inventor of the percussion lock and primer for firearms Forsyth was born in 1769 at Belhelvie, Aberdeenshire, and died there on June 11, 1843. A graduate of King's College, Aberdeen, he succeeded his father as minister at Belhelvie He was interested in the scientific discoveries of his time, and was a chemist and a practical mechanic, following up experiments made many years before in France, he succeeded in constructing a percussion lock which, with the use of detonating compounds, eventually superseded the old flint lock that had been in use for two hundred years Forsyth's invention was made in 1803, and in 1806 he carried out experiments in the Tower of London. It was not until 1834, however, that the percussion lock was adopted for the British army. Interest in his work has been renewed by the presentation to the Tower Armouries of examples of early English firearms by Prof Reid, of Aberdeen, one of the few surviving relatives of Forsyth The movement has the support of the Gunmakers' Company and the Gunmakers' Association, and particulars of the proposal for a memorial can be obtained from the Curator of the Armouries, Tower of London.

ON April 24 Mr Dendy Marshall read a paper to the Newcomen Society on "The Rainhill Locomotive Trials of 1829." These famous trials actually took place in October 1829, the four competing engines being the 'Rocket,' 'Novelty,' 'Sans Pareil,' and 'Perseverance.' At that time the Liverpool and Manchester Railway was nearing completion, but though some fifty locomotives had been constructed

in England and many of these were in daily use at various mines and on the Stockton and Darlington line, the directors of the Liverpool line were still in doubt as to whether to use stationary engines with rope haulage or locomotives It was on the advice of the well-known engineers Rastrick and James Walker that a prize of £500 was offered for a locomotive which should be "a decided improvement on those now in use, as respects the consumption of smoke, increased speed, adequate power and moderate weight" Of the four engines entered, only the 'Rocket' fulfilled all the conditions and went through the trials satisfactorily, a performance which did much to establish the locomotive in an unrivalled position as the motive power of the future The design was due to the collaboration of George and Robert Stephenson and Henry Booth, and the engine was the first locomotive containing the present features of a roomy fire-box combined with a tubular boiler The 'Rocket' was employed on the Liverpool and Manchester Railway until 1836, when it was sold for £300 It then worked on the Midgeholm Colliery until 1844, and in 1862 was secured by Bennet Woodcroft for the Patent Office Museum, from which it passed to the Science Museum, where it is one of the most attractive of many historic relics of the past. Simultaneously with the meeting of the Newcomen Society in Caxton Hall, the American members of the Society held a meeting in New York, at which Mr Dendy Marshall's paper was also read. An abridgment of the paper appeared in the *Engineer* for April 26.

THE atmosphere of incredulity surrounding the subject of the 'sea-serpent' tends to obscure the fact that several varieties of true sea-snake are frequently met with in the Indian Ocean and other tropical waters Little, however, is known of their habits, a deficiency which adds interest to a recent report from the steam trawler *Humphrey*, Capt John MacDonald On Dec. 22, 1928, while steaming eastward from Torres Strait, a commotion was observed in the water about four miles from Double Island, and on closing it a large fish was seen to be struggling in the coils of a sea-snake, which was engaged in rapidly striking the fish's head with its own On the ship's approach, the snake sank slowly with its prey, which it had apparently succeeded in stunning The snake is described as being striped with bright yellow and dull brown, in rings, a coloration which points to its having been a *Platurus fasciatus* Later in the same day, several similar snakes were seen, ranging from three to nine feet in length. According to the *Humphrey*, they are not uncommon in these waters, and craft at anchor are accustomed to plug their hawse-pipes in order to prevent the snakes, whose bite is reputed to be poisonous, from coming on board by climbing the anchor-cables.

AT a meeting of the Linnean Society of London on April 18, Sir Sidney Harmer read extracts from correspondence relating to the habits and probable end of "Pelorus Jack," probably a specimen of Risso's dolphin, which for many years accompanied ships through Pelorus Sound, at the northern extremity of South Island, New Zealand "Pelorus Jack" was shot at several times, but after 1904 was protected by successive Orders in Council of the Government of New Zealand. The animal used to escort steamers appearing in the Sound for about 5 miles, leaping and gambolling under their bows It is thought that it was killed about April 1912, possibly by a twin-screw steamer which took the place of a single-screw vessel formerly plying on a route passing through Pelorus Sound. In the discussion which followed, Dr. G P Bidder referred to an experience of his own off Plymouth in a 3-ton cutter. Five or six porpoises played close alongside, one within reach from the steersman's seat, but none touched the boat. Mr. H N Ridley stated that off the Dindings, on the coast of the Malayan Peninsula, his launch had been repeatedly escorted by dolphins, which rubbed against the boat and played so close to it that they could be slapped. The general opinion was that dolphins do not rub against vessels to clear themselves of barnacles, as has often been suggested. Dr Bidder stated that the size and character of the dolphin's brain are such that it is capable of delighting in exhibiting skill and may be attracted to a ship by its noises. The classical stories of the friendliness of dolphins towards mankind may not be quite so incredible as we have supposed.

THIS year the State of Western Australia celebrates its centenary. An article in the *Nineteenth Century* for April by Mr. J. W Kirwan recounts some of the remarkable developments in that part of Australia during the last hundred years Although known to the Portuguese and Dutch at least from the seventeenth century, no notice was taken of Western Australia until early in the nineteenth century. It was only in May 1829 that formal possession was taken by Great Britain of the west coast of New Holland and a settlement was founded on Swan River At the end of that year the new colony contained only 850 settlers The struggle that faced them was severe. Knowledge of conditions had to be learnt slowly, and the aborigines were none too friendly. After five or six years the colony had made little progress Then the introduction of penal labour improved matters, and most of the new settlers turned into good colonists. But it was the gold rush in the eighties and nineties of last century that set the colony on its feet and raised it from poverty and stagnation to prosperity and progress. The gold rush brought men of ability and enterprise as well as others of little value Public works were undertaken, the agricultural wealth of the State was realised, and steady and continuous development begun. The population is now above 400,000 and there is ample space for many more.

ON April 24 a Fairey monoplane, piloted by Squadron-Leader A. G. Jones-Williams and Flight-Lieutenant N. H. Jenkins, left Cranwell Aerodrome, Lincolnshire, with the intention of making a non-stop flight to Bangalore, India According to the Karachi correspondent of the *Times*, they passed over that city on the afternoon of April 26, and shortly afterwards returned and descended owing to lack of

petrol. They had flown a distance of approximately 4130 miles in 50 hours 48 minutes, Karachi was reached in a little more than 48 hours The monoplane was specially designed for the journey, and was fitted with a Napier Lion engine giving 530 h p. at full throttle. Its weight when fully loaded was about 16,000 lb, and it is estimated that a further 1000 lb of fuel could have been carried had a suitable runway been available for the start. The average speed for the first 2000 miles was 96 miles an hour, but along the Persian Gulf the average dropped to 70 miles an hour, the airmen travelling at a height of about 10,000 feet, being unaware of a favourable wind up to about 6000 feet

RECENT additions to the Department of Entomology of the British Museum (Natural History) include a further batch of insects presented by Mr R. E Turner, which, with the consignment announced last autumn, makes a total of 13,946 insects of various orders collected by him in South and South-west Africa during 1928 Upwards of 6000 of these specimens are Hymenoptera, upon which Mr. Turner is a well-known authority, while some 4000 are Coleoptera (beetles) But all orders of insects are represented in this donation, which, when fully worked out, will form a most valuable contribution to the knowledge of the insect fauna of the southern extremity of the African continent, especially since many of the specimens were obtained in localities where little if any collecting has hitherto been done Prof V M Goldschmidt, of Oslo, has presented to the Mineral Department of the Museum both rough and faceted specimens of olivine of gem quality recently discovered in western Norway. Mr. G. Tandy, of the Department of Botany, who has recently spent five months with the Great Barrier Reef Expedition, has brought back a large number of specimens illustrating the marine flora of the Reef and adjacent areas, which are being added to the botanical collections.

IT is announced that the first Congress of the International Society for Microbiology, which was fixed to take place in Paris in October 1929, has been definitely postponed to June 25, 1930. The programme, which has already been published in various scientific journals, will stand.

AFTER fifty years in the service of the Royal Institution, Mr Henry Young is about to retire from his post as assistant secretary and keeper of the library. He was engaged as an assistant in the library in 1879, when Tyndall was the resident professor, and was promoted ten years later to the position which he now occupies. He has been a devoted servant to the Institution and a familiar friend to a large number of the members The Royal Institution is full, as is well known, of interesting and honourable traditions, and Mr Young has been and still is one of the chief agents of their preservation. In his place Mr. Thomas Martin, at present secretary to the Institute of Physics, has been appointed as general secretary, Mr Ralph Cory, assistant in the library, becomes librarian.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A first assistant in the Clinical Laboratory of the Manchester Royal Infirmary—The General Superintendent and Secretary, Royal Infirmary, Manchester (May 8). A public analyst for the City of Salford—The Medical Officer of Health, 143 Regent Road, Salford (May 11). A ballistic research officer under the Ordnance Committee—The Secretary, Ordnance Committee, Royal Arsenal, Woolwich, S.E 18 (May 11). A lecturer in pharmacy at the Belfast Municipal College of Technology—The Principal, Municipal College of Technology, Belfast (May 14) An assistant morbid anatomist and curator of the museum of the Royal Free Hospital and London School of Medicine for Women—The Secretary, Royal Free Hospital, Gray's Inn Road, W C 1, or The Warden and Secretary, London (R F.H) School of Medicine for Women, Hunter Street, W.C 1 (May 15). A lecturer in biology at the Portsmouth Municipal College—The Secretary, Offices for Higher Education, Municipal College, Portsmouth (May 25) A technical officer and a junior technical officer at the Royal Aircraft Establishment, for work relating to the development of instruments and allied equipment for aircraft use—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (May 25). An assistant lecturer in physics in the University of Manchester—The Registrar, The University, Manchester (May 25). An assistant lecturer in zoology in the University of Bristol—The Secretary, The University, Bristol (June 1) An assistant lecturer in economics at the University College of North Wales, Bangor—The Registrar, University College of North Wales, Bangor (June 8). An assistant in natural history at University College, Galway—The Secretary, University College, Galway (June 8). An assistant in the Mechanical Engineering Section of the Engineering Department of the Halifax Municipal Technical College—The Principal, Municipal Technical College, Halifax. A master for building subjects in the Southall Junior Technical School—The Principal, Junior Technical School, Southall, Middlesex A resident lecturer in science, biology and botany, elementary chemistry and physics, at St Gabriel's Training College for Women—The Principal, St. Gabriel's Training College for Women, Camberwell. A lecturer on physics and chemistry at the Maria Grey Training College—The Principal, Maria Grey Training College, Salusbury Road, N W.6. A technical assistant in the Department of Entomology of the Museum of Zoology, Cambridge—C. Forster Cooper, Superintendent, The Museum of Zoology, Cambridge. An experienced shorthand-typist-secretary for library work, indexing and correspondence, at the Research Station, East Malling—The Imperial Bureau of Fruit Production, Research Station, East Malling, Kent

ERRATUM.—In the article on "High-Voltage Alternators for the Grid" in NATURE of April 13, p. 586, "25 kilowatts" on line 33, and "10 kilowatts" on line 34, of the second column, should read "25,000 kilowatts" and "10,000 kilowatts" respectively.

Research Items.

A REMARKABLE OBJECT FROM BENEATH THE RED CRAG.—In *Man* for April, Mr. J. Reid Moir describes a remarkable object obtained from beneath the Red Crag at a pit on the north bank of the River Gipping at Bramford, near Ipswich. It was obtained from the detritus-bed lying below loamy sand, which in turn was below glacial gravel. The bed lies at about 100 O.D. upon the surface of the London Clay. It is made up of typical sub-crag detrital material and does not exhibit any signs of glacial disturbance. The object was discovered in 1926, but beyond being labelled, was not specially noted until attention was directed to its remarkable character by the Abbé Breuil, who, on examining it, pronounced it shaped by the hand of man. In shape it is like an elongated egg with one end slightly blunter than the other. At each end is a small depression or punctuation, and similar marks are visible on other parts—in places four or five being grouped together as a rhomboid or as straight lines. It is possible that these may be due to decomposition of crystalline grains. The whole surface has been scraped with a flint, so that it is covered with a series of facets running fairly regularly from end to end. From each one is made up a number of longitudinal striations of unequal depth; *a number of fine concentric incisions are visible at* one of the poles. The specimen is of a greyish-brown colour, weighs approximately $\frac{1}{2}$ ounce, and measures at its greatest length $1\frac{6}{16}$ in., and at its greatest depth $\frac{14}{16}$ in. The exact nature of its material is in doubt. The Abbé Breuil compares it with the steatite sling stones of New Caledonia.

TLINGIT EMBLEMS.—In the *Museum Journal* (Philadelphia) for December last, Mr. Louis Shotridge describes a number of ancient clan emblems of the Tlingit of Alaska; these formed part of a collection of ancient objects representative of the traditional art of this people which he was able to collect solely in virtue of the fact that he himself was a Tlingit of noble birth. These objects, it is stated, had not seen the light since the introduction of the white man's religion and law. The emblems are in the form of ceremonial head-dresses, each of a once generally recognised grade in rank and importance. The Tlingit were divided into two nations, each of which was subdivided into clans. Each clan had its ceremonial head-dress, but its possession was often the subject of dispute and the cause of internecine war. On the side of the Tlhigh-naedi nation, first in importance was the raven hat, which signified culture; next in order the whale hat, an emblem of greatness and the cult object of the greatest clan. The frog hat signified persistence and was the emblem of the Kiks-adi clan. On the side of the Shungookaedi nation were the eagle, the grizzly bear, the emblem of power, and the wolf, signifying courage. The hats are for the most part woven of roots of the spruce, with highly conventionalised representations of the head or other part of the animal simulated carved in wood and ornamented with locks of human hair. On most there was a 'top-stock' of spruce roots, woven to resemble a number of interlocking cylindrical boxes superimposed which could be made to expand or contract. The number of these boxes or divisions represents the number of ceremonies in which each hat was used.

LESSONS FROM THE HUMAN FOOT.—In the third lecture in memory of Hugh Owen Thomas, delivered before the Medical Institution at Liverpool on May 11, 1928, Sir Arthur Keith discussed some of the problems of the human foot (*Jour. Bone and Joint Surgery*, January 1929). He looked upon the sequence of postural functions as a more promising line of investigation than anatomical details, and took it as proved that the human foot had been evolved from a prehensile foot, the nearest representative of the primitive form being that of the chimpanzee. The chief changes which transformed the prehensile into plantigrade were due to growth—a recession of growth of the external or planar limb of the prehensile foot with a progressive growth in the hallucial limb. Three stages of this growth-development can be followed: the pronograde prehensile foot, the small orthograde foot (hylobatian), the massive orthograde foot (troglodytian) leading to the human plantigrade. The mass of the body has been the most important factor in bringing about the later changes, and it is inferred that it was the weight of the body which compelled man's anthropoid ancestors to assume terrestrial habits of life, and that man is the descendant not of a pigmy anthropoid but of one of massive body.

RURAL POPULATION OF NEW YORK STATE.—In a study of the movements of population in New York State from 1855 to 1925 (Cornell University Agricultural Experiment Station, *Memoir* 116) Mr. B. L. Melvin brings to light a number of interesting facts especially with regard to recent years. While the population of New York State increased 7.5 per cent from 1920 to 1925, the total city population, including New York City, grew less than did other classes, and the larger cities gained less than the smaller ones. Suburbanisation was the most marked phenomenon in the shifting of population in that period. As a result, rural population increased, especially in those counties where urban influences were most dominant. That this increase was due to urban influences, provided no doubt by improved transport, seems to be clear from the fact that farm population increased only in suburban counties but decreased in all others. Cities seem to maintain the farm population near them rather than to cause its decline. In such a study, of course, the use of terms is somewhat arbitrary. Mr. Melvin classes as rural population all persons living outside places of population 2500 and above. The pamphlet is well illustrated with distributional maps.

MIGRATIONS OF THE ARCTIC TERN.—A *Daily Science News Bulletin*, issued by Science Service, Washington, D.C., announces that an Arctic tern, ringed as a fledgling at Turnevik Bay, Labrador, on July 28, 1928, was found dead on the beach at Margate, fifteen miles south-west of Port Shepstone, Natal, South Africa, on Nov. 14, 1928. This is a remarkable record, not only for the distance covered, but also for the fact that the bird could have been only about three months old at the time of the flight. It suggests the possibility that the birds, which are rarely or never seen on the south Atlantic coast of the United States, may cross the ocean to Europe and then proceed south. The extensive migrations of the Arctic tern are well known, and owing to its habit of breeding in the northern portion of the northern hemisphere and of wintering in the far south, it enjoys more hours of sunlight than any other living creature. In the northern part of its breeding range and during its stay in the Antarctic regions, it lives practically in continuous daylight.

GENITALIA AND GENITAL DUCTS OF INSECTS.—C. J. George (*Quart. Jour. Micr. Sci.*, vol. 72, part 3) has examined the development and morphology of

the genitalia of Homoptera, as represented by the frog-hopper, *Philænus*, and of Zygoptera as represented by *Agrion* (one of the demoiselle flies) and sets down the homologies of the parts. As the result of studies on the development of the genital ducts, he concludes that the vaginal opening in Orthoptera, Hymenoptera, Homoptera, Diptera, and Lepidoptera is homologous, and that the vaginal opening in Coleoptera is homologous with the oviducal opening of Lepidoptera and with the opening of the accessory gland of Homoptera, Hymenoptera, Diptera, and Isoptera. The common oviduct, being formed differently in the different groups, is not homologous, and the accessory organs, for example, spermatheca, are not homologous. The author discusses the probable lines of evolution of the female ducts in Insecta, and points out that the Ephemeroptera with their double female openings on the seventh abdominal segment exhibit an ancient condition, and that many higher insects pass through this condition during their larval and nymphal stages. The existence of an ectodermal invagination behind the seventh abdominal segment in Homoptera and Orthoptera shows that the acquisition of a single gonopore was the next step. The later ontogenetic history shows that there has been a tendency to shift the gonopore to the terminal abdominal segments. The conclusion is that the Orthoptera, Homoptera, Lepidoptera, and Diptera are closely allied, but the Coleoptera have had a different line of evolution.

Chromosome Linkage in *Œnothera* Hybrids.—Prof. R. R. Gates and F. M. L. Sheffield, in *Phil. Trans. Royal Soc.*, B, vol. 217, 367 (1929), have published an account of important cytological researches on reciprocal hybrids obtained from *Œnothera ammophila* and *Œ.* (*biennis* × *rubricalyx*). The reciprocal F_1 hybrids are very different and are patroclinous. The chromosome linkages were found to be unlike in the reciprocal hybrids. In *Œ. ammophila* × (*biennis* × *rubricalyx*) the spireme segments in diakinesis into three free pairs of chromosomes and a ring of eight. In the reciprocal cross there are, on the contrary, seven chromosome ring pairs. That the latter has all its chromosomes paired makes it clear that complete pairing is not necessarily a sign of the homozygous condition. The conclusion is reached that since the same two haploid sets of chromosomes are present in the reciprocal hybrids, the cytoplasm plays a part in determining what pairing shall take place; it influences the attractions between the chromosomes and the distribution of chromosomes in the reduction division. This leads in itself to a departure from usual Mendelian behaviour. The production in F_1 of true breeding hybrid types is to be explained through the occurrence of chromosome linkage, which prevents free assortment of the chromosome pairs, and hence of the differential characters. Linkage differences in *Œnothera* occur in wild species as in mutations arising in controlled experiments. It seems, therefore, that evolution can occur through germinal changes (mutations) of various kinds arising in a succession of species which are of natural hybrid origin, but, in the main, breed true because of their persistent chromosome linkages in meiosis. In this probable sequence we have suggested a new evolutionary phenomenon which may be of much significance for the student of the origin of species.

A New 'Deep' in the Pacific.—A *Daily Science News Bulletin*, issued by Science Service, Washington, D.C., announces that the non-magnetic ship *Carnegie*, now cruising in the Pacific Ocean, has discovered a new deep some fifty miles west of Tahiti. The greatest depth was 5400 metres, and its area does not seem to be extensive. The observations were made with the sonic depth-finder. Captain Ault named the depression the Bauer deep, after the director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington. A further discovery was that of a submarine ridge in approximately lat. 23° S. and long. 80° W. This seems to be a northward extension of the ridge on which the San Felix Islands lie. It was named the Merriam ridge. Other oceanographical discoveries were made, but details are not yet given.

Ice in the Arctic Sea.—The Danish Meteorological Institute has published in the *Nautisk-Meteorologisk Aarbog*, 1928, its usual report on the state of the ice in Arctic Seas during the year. Most of the observations are naturally for the summer months, but off south-west Greenland, western Spitsbergen, and in the North Atlantic it is possible to give reports for all months. In the Barents and Kara Seas there was less ice than usual in the summer. Franz Josef Land could be reached in August, while in September there was even water between some of the islands of the archipelago. In Spitsbergen waters conditions were favourable except for unusually late streams of pack-ice on the south-west coast. In August and September Spitsbergen could be circumnavigated without difficulty. The east coast of Greenland had rather more ice than usual, and this state of affairs was found also in the east of Spitsbergen. On the other hand, there seems to be no evidence of an increased outflow of pack-ice by the other outlets of the Arctic Sea. Davis Strait and Baffin Bay had rather less ice than usual. Reports from the Bering Sea are few and vague. Iceland coasts were practically free throughout the year. On the Newfoundland Banks pack-ice was below the normal in every month, but icebergs were much above the normal in April, May, and June. The report is illustrated with the usual charts for the spring and summer months.

Raman Effect and the Spectrum of Hydrogen.—In Nature, Jan. 26, p. 127, Prof. H. S. Allen suggested the view that many of the faint lines in the secondary spectrum of hydrogen may result from the bombardment of hydrogen molecules by light quanta of frequencies corresponding to the Balmer lines. A table was given for the first five Balmer lines showing a number of possible Raman lines having frequency differences with respect to the exciting line which were integral multiples of a particular wave number. Dr. D. B. Deodhar, Physics Department, University of Lucknow, in a letter to the Editor, states that he has made a further search in this direction, using the recently published wave-length tables of Finkelnburg, and for ten members of the Balmer series has found a large number of lines, both of lower as well as of higher frequencies, which approximately occupy the positions of Raman lines. Finkelnburg's experimental tube was energised with 2000 volts, giving a discharge current of 600 ma., while the current in Gale, Monk, and Lee's tube was only 20 ma. Finkelnburg discovered about 2000 lines which were previously unknown in the spectrum of hydrogen. The intensity of the Balmer lines in his experiments was considerably greater than in those of Gale, Monk, and Lee. It is interesting to note that a majority of the Raman lines of *increased* frequency belong to the newly discovered lines, and that they are of very low intensity. Dr. Deodhar expresses the opinion that his results strongly corroborate the view put forward by Prof. Allen; but, in consideration of the high accuracy of recent measurements of wave-lengths in the hydrogen spectrum, it may be well to scrutinise such results very carefully.

MOLECULAR RAYS.—Some experiments performed with beams of molecules by Prof. O. Stern and F. Knauer (*Zeitschrift fur Physik*, Mar. 7) furnish good qualitative evidence that particles of atomic dimensions, as well as electrons, behave as waves in certain circumstances. The de Broglie waves of a hydrogen molecule at room temperatures gave an average wave-length of about 1 A., and should therefore be reflected specularly from a well-polished mirror if they are incident upon it at an angle of the order of a thousandth of a radian, as are X-rays of corresponding wave-length. This has been shown to be the case; the efficiency of reflection is greater the less the glancing angle, and the angle at which reflection first becomes marked is about that which would be expected from the size of the irregularities on the polished surface, whilst the amount of reflection increases as the temperature of the beam of molecular rays is lowered, that is, as the equivalent wave-length of the particles is increased. Prof. Stern was unable to obtain any positive results in an attempt to diffract molecules from a ruled grating, but his results with a crystal surface, although not quite definite, are compatible with the idea that diffraction takes place in this case.

LOAD AND TARIFF IN ELECTRIC SUPPLY.—The standard method of distributing electrical energy in Great Britain is by means of three wires carrying alternating currents, the phases of the currents in each wire being different. The consumer's load can either be connected in mesh (like a triangle) or in star (the three wires being joined together at one point). When the load is balanced, the measurement of the power taken presents no difficulty. When, however, the power expended in each of the three arms is different, the problem becomes complex and the ordinary methods of measurement give no useful or sufficient indication of the nature of the load taken by a consumer. In addition to the values of the three currents in the arms, we have to take into account the phase differences between these currents and the electromotive forces driving them. This problem, which is almost purely mathematical, was discussed in a paper by E. W. Hill, read to the Institution of Electrical Engineers on April 5. The solution arrived at, however, whilst possibly better than some of the methods at present in use, appears to us not to classify consumer's loads in a truly equitable way. If the assumption is made that all the waves follow the harmonic law, the solution given by Russell, which is referred to in the paper, seems to be a satisfactory one. The general case, however, yet remains to be solved, although a very large number of papers have been written on the subject, especially in America. There are few industrial applications where mathematics can be more usefully employed than in electrical engineering.

GEOGRAPHICAL INFLUENCES AND RADIO WAVES.—In the *Revue Scientifique* for Mar. 23, R. Bureau, of the French meteorological office, gives data which show that ordinary meteorological and geographical causes exert a very appreciable influence on the propagation of radio waves. In the early days the hypothesis of a conducting layer in the upper atmosphere was a great help in enabling us to picture how part of the radio energy flowed round the earth. With waves the frequency of which exceeds 6000 kilocycles (wave-length less than 50 metres) it gives a fairly satisfactory explanation of the 'zones of silence' observed in practice. It is now accepted, however, that the height of this layer is a quantity varying at different times of the day and that there are possibly several conducting layers at different heights. Apart, however, from what happens in the upper atmosphere, important effects are produced in the troposphere, which is about six miles in height, and in the lower layers of the stratosphere. Contrary to expectation, direct experiment has shown that the surface which separates the stratosphere from the troposphere has little, if any, effect on the propagation of the waves. It is found that short waves, whether entering or leaving France, have very different properties, which depend on their direction of propagation. Waves coming from the Caribbean Sea, Panama, and the Gulf of Mexico suffer little attenuation. On the other hand it is, if not impossible, at least very difficult to get signals from the north-east of the United States and from Newfoundland. Signals given by a 200-watt emitter on the Atlantic coast of Morocco seem never to reach central or eastern Europe, although they can be heard in other directions for thousands of miles. The radio waves seem to have difficulty in passing through the surface of separation between a mass of cold air and a mass of warm air. The lines which separate the audible zones from the zones of silence often coincide very closely with the meteorological lines separating masses of cold and warm air.

CRYSTAL STRUCTURE OF β-THALLIUM.—At the ordinary temperatures, α-thallium has a hexagonal close-packed lattice. Drs. Nishikawa and Asahara have shown by X-ray methods that it has an inversion point at about 230° C. The change in crystal form consequent upon this has been investigated by Mr. Sinkiti Sekito, of the Research Institute for Iron, Steel, and other Metals, Sendai, Japan, who has sent us a short communication on the subject. The metal was retained in the form stable above the inversion temperature by quenching it in iced water. Photograms were then prepared, using a chromium anticathode and taking the wave-length as $CrK_{\alpha} = 2.287$, $CrK_{\beta} = 2.080$. It appears from these that β-thallium has a face-centred cubic lattice ($a = 4.841$). Calculating the specific gravity from this value, the figure 11.86 is obtained, which agrees well with the results obtained by other methods. A similar face-centred cubic structure was obtained with thallium alloys containing bismuth, lead, antimony, or tin in solid solution. Mr. Sekito concludes, therefore, that the face-centredness of thallium above 230° C. has been definitely established.

HYDRATES OF CADMIUM SULPHATE.—The hydration of cadmium sulphate was for long the subject of controversy, until Hauer and also Rammelsberg showed that, at ordinary temperatures and pressures, this salt crystallises from its solutions as the monoclinic hydrate, $CdSO_4$, 2.67 H_2O. This result was confirmed by later investigators and, as a consequence of vapour pressure measurements by Carpenter and Jette in 1923, the temperature of transformation into the monohydrate was given as 41·5°. A systematic study of the dehydration of this salt, carried out by Prof. Luca Coniglio, is recorded in the *Rendiconti* of the Academy of Physical and Mathematical Sciences of Naples for January–April 1928. The experimental data show that at 74°, $CdSO_4$, $\frac{8}{3}H_2O$ loses $\frac{5}{3}H_2O$, giving the monohydrate, which is stable until the temperature reaches about 120°, when further expulsion of water occurs, with formation of $3CdSO_4$, $2H_2O$. The latter hydrate is stable at temperatures below about 138°, when another molecule of water is lost, giving $3CdSO_4$, H_2O, which is converted, but only comparatively slowly, into the anhydrous salt at 150°. It seems probable that the water of crystallisation of the original salt is combined, not with a single molecule, but with three molecules, of the cadmium sulphate, the formula being $3CdSO_4$, $8H_2O$.

Developments of British Chemical Manufactures.

At the instance of the British Science Guild, a public meeting was held at the Mansion House, London, on April 24, when an account was given of certain phases in the development of British chemical industry Lord Melchett, who presided, referred briefly to the origin and the present status of the nitrogen industry, remarking that although the synthetic ammonia industry has grown up in the last few years, the problem of the supply of artificial fertilisers is by no means new Nevertheless, older sources of combined nitrogen were inadequate, and had the new industry not been created the fields of the world would soon have starved for one of the most elemental necessities The new textile also, originally a British conception, has proved applicable in numerous directions, whilst the drug industry is proceeding in the direction of the synthesis of highly complex substances Other manufactures are equally dependent on the prosecution of scientific research, and the value of such research should be more fully realised

Sir Frederick Keeble then addressed the meeting on "Fertilisers from the Air," saying that, like the legendary discovery by Prometheus of fire, fertilisers have been brought down from heaven by modern chemists. Without sufficient nitrogen in the form of salts of ammonia or nitrates, the green plant is unable to manufacture sugars and proteins at its maximum capacity, lack of available nitrogen has always limited life on this planet. Natural processes are too slow for the modern world, and before the year 1913 a general nitrogen-hunger had become apparent. Now, however, the nitrogen of the air is being made into fertilisers at the rate of more than one million tons a year, drawing on a supply so vast that, at the present rate of use, it will last for four thousand million years. Farmers are now acquiring the habit of using larger quantities of nitrogenous and other fertilisers, Holland leads the way, followed by Belgium, Germany, Japan, Egypt, Great Britain, and France, whilst the use of nitrogenous fertilisers in the United States of America is well below that of Western European countries The material is now one of our cheapest commodities, and thus provides the farmer with the best means of reducing costs and of obtaining improved economic results from his farm Sir Frederick then outlined the origin and development of the great factory at Billingham, where attention is now being directed to the manufacture of fertilisers containing other plant foods in addition to nitrogen.

The 'rayon' (artificial silk) industry was described by Mr. A. B Shearer, who insisted that the use of the expression 'artificial silk' only keeps alive an erroneous impression of inferiority, since the new textile is no more artificial than is steel or many other manufactured products, and since it possesses none of the chemical, and few of the physical, characteristics of silk. The four principal processes involved, in order of their industrial development, are those known as the nitrocellulose, cuprammonium, viscose, and cellulose acetate processes. Nitrocellulose was first used in 1883 to produce a continuous cellulose thread by Sir Joseph Swan, who in 1885 exhibited fabrics made from his yarns, whilst a year later Count Hilaire de Chardonnet became the first producer of rayon for textile purposes. After briefly indicating the nature of the processes employed in the production of these textile fibres, Mr. Shearer emphasised the debt which the new industry owes to scientific discovery, and showed how the new fabrics successfully minister to the needs created by changes in the habits and outlook of civilised peoples. The difficulties of establishing a new industry are seldom realised, but it must be placed to the credit of British organisation, business foresight, engineering skill, textile technology, and salesmanship, that Great Britain has been able to take and maintain the lead in this great industry. Moreover, the use of rayon has had a marked effect on the general condition of the textile industries, its special requirements leading to generally applicable improved methods of manufacture and treatment, in the application of which the worker has benefited

Mr F H. Carr spoke of developments in the study and manufacture, particularly in Great Britain, of synthetic drugs The great success of salvarsan provided a strong incentive for the search for other synthetic drugs which exert an antagonistic effect on disease organisms without injuring the infected person, for example, various organic compounds of arsenic and antimony are now employed, especially in the treatment of certain tropical diseases In its normal chemical processes the body is continually producing active principles, chemical substances, which control and regulate its action. A study of these substances has led to the possibility of their replacement, in cases of deficiency, by synthetic, or at least externally prepared, substances Insulin has not yet been made synthetically, but adrenaline, secreted by the suprarenal gland, has been synthesised, and, moreover, nearly related compounds with other valuable medicinal properties have been prepared. Mr. Carr also referred to the synthesis of ephedrine, an alkaloid which occurs in the Chinese plant Ma-huang, this substance powerfully relieves the distressing effects of asthma. Vitamin-D is now made by the action of ultra-violet light on ergosterol, a substance derived from yeast

Mr. Carr sketched the progress of the medicinal chemical industry in Great Britain, and remarked that to-day there are important manufacturing firms which, between them, are making most of the synthetic drugs. The fact that there are some exceptions, chiefly substances derived from intermediates employed in the manufacture of dyes, shows that the organisation of chemical industry in Great Britain, although it has made rapid strides, has not yet been completed The changes which have occurred in chemical industry of late years are in large measure the result of the mutual approach and understanding which have already taken place between the business, the scientific, and the practical men in the industry. Future progress lies in extending the use of science in the industry, in the first place by promoting research in industrial laboratories in the closest possible relationship with that carried out in academic institutions and under the ægis of the Medical Research Council, and, secondly, by finding employment for greater numbers of scientifically trained staffs and workers to whom is given responsibility and a living interest in the work they are performing.

Sir Richard Gregory, who proposed a vote of thanks to the chairman, said that the fact that scientific research leads not only to new outlets for employment but also to the creation of entirely new industries is too often overlooked by politicians. British scientific capacity is at least as great as that of any other people in the world, and he hoped that it would be yet more fully employed in such development and creation.

Radium Requirements of Great Britain.

ON July 7, 1928, the chairman of the Committee of Civil Research appointed a sub-committee, with the Right Hon Lord Rayleigh as chairman, to examine the radium requirements of Great Britain in relation to the present sources of supply and to submit recommendations The Report of the Radium Sub-Committee (dated Mar. 7, 1929) has now been published (London H M. Stationery Office. 6*d*) The document is of absorbing interest, for it not only discusses the importance of radium in medical treatment and the amount required for such purposes in Great Britain, but it also presents a valuable survey of the sources of radium production, with special reference to deposits in the British Empire. Among the conclusions reached are the following

The amount of radium belonging to the Government which is available for medical purposes in England, Scotland, and Wales is 2 2 grams, and the estimated amount believed to be the property of hospitals and private medical practitioners, or likely to be so in (say) three months' time, is approximately 22·7 grams, making a total of 24·9 (or say 25) grams.

The amount required to meet existing needs in Great Britain is probably approximately 49 or 50 grams, that is, an immediate addition of about 24 grams to the existing national stock is required

Owing to the lack of trained personnel and to the inadequacy of the available hospital accommodation, it is probable that not more than 20 additional grams of radium could be effectively absorbed for medical purposes by the end of 1930.

There exists a pressing need for the establishment of a central stock of radium and the organisation of some systematic method for its distribution.

Until sources of supply at present unproved or unknown are discovered in the Empire or elsewhere, the only source from which additional supplies of radium for medical purposes are obtainable in any quantity is the Belgian Congo.

The following are the chief recommendations submitted .

Steps should be taken at once to ensure the acquisition by instalments of 20 additional grams of radium element for medical purposes.

A body of trustees should be appointed entitled the National Radium Trustees, whose duty it should be to hold the funds provided by Parliament or otherwise, and to purchase therewith and hold radium for use by the Radium Commission referred to below

The National Radium Trustees should appoint a body to be called "The Radium Commission," who should have the following powers and duties

Generally to deal with the custody, distribution, and use of all radium held by the trustees, having regard to the advancement of knowledge, the treatment of the sick, and economy of use , and, in particular, to consider and approve plans submitted to them for the use of radium for the purposes of medical treatment and research, and to make the necessary arrangements for the supply of radium for such uses

As was announced in our issue of April 27, p 649, the Government has accepted the financial recommendation of the Sub-Committee, and will contribute £1 for every £1 of private subscription up to £100,000 for the purchase of radium This leaves a sum of £150,000 to be raised by private subscription if the quantity of radium required is to be purchased A double appeal has now been issued An anonymous donor has given £100,000 to King Edward's Hospital Fund for London, to form the nucleus of a thank-offering fund for the recovery of His Majesty the King, and the *Times* has undertaken to raise the £150,000 required for the National Radium Fund The two movements are in close co-operation and have the same treasurer and office organisation. The King has signified his approval of the scheme by sending a cheque for £1000, to be divided equally between the two appeals, and other members of the Royal family have contributed. The eagerness of the public to express its thankfulness for the King's restoration to health has been marked by its swift response to the appeals, nearly £60,000 being subscribed to the National Radium Fund on the day it was opened Further subscriptions, for either fund, should be addressed "The Treasurer, Thank-offering Fund, 103 Kingsway, W C 2.

Annual Meeting of the International Council for the Exploration of the Sea.

THE annual meeting of the International Council for the Exploration of the Sea was held in London on April 8–15. The meetings of the area and other committees took place at the House of Lords, and the rooms of the Zoological Society were placed at the disposal of the Council for the scientific meetings held on April 12 and 13. About sixty delegates and experts attended the meetings.

The main work of the Council is organised on a regional basis, and the investigations carried out in each geographical area are reviewed by the area committees, which also lay down the programmes for the ensuing year. Hydrography, plankton, statistics, and the study of salmon and trout are dealt with by special non-area committees.

At the Hydrographical Committee, the main points under discussion were the preparation of mean surface salinity charts for the North Sea, plans for combined work on submarine waves in the Kattegat, and the hydrography of the Faroe-Shetland Channel , regular observations of the surface waters on two additional lines in the North Sea were arranged. Prof. W. Mielck presented a report to the Plankton Committee on the work he has carried out in testing the comparative catching-power of various types of plankton nets, and Prof. H. H. Gran initiated a discussion on quantitative methods used in the investigation of phytoplankton. In the Altantic Slope Committee, under the chairmanship of Dr E. D. le Danois, Prof. A. Ramalho gave an account of the Portuguese hydrographical work in the area, including the Straits of Gibraltar and the adjacent Portuguese, Spanish, and Moroccan coasts, and Dr. Fernando de Buen demonstrated an inverse correlation between the catches of sardines and sprats, as shown by both English and Portuguese statistics. Dr. R S. Clark gave a detailed account to the Northern North Sea Committee, of the distribution of the young herrings of the northern waters of Great Britain, and Dr. A. Molander contributed notes on the witch fishery of the area. Dr. A. Bowman, the chairman, read a paper on the age determination of the lemon sole by means of scales. In the meetings of the Southern North Sea and Combined North Sea Committees the advisability of continuing the practice of issuing advance proofs of the tables from the *Bulletin Hydro-*

graphique to people concerned, was discussed. It was decided that this procedure was very helpful and should continue

Prof A. C. Hardy showed a new model of his continuous plankton recorder, which it is hoped will be of great service in enabling plankton collections to be made from commercial vessels A question which is becoming of great practical importance, namely, the design of fishing gear which will avoid the wasteful destruction of small fish, was discussed by a special Committee on Savings Gear, in the light of experiments carried out in several countries during the past year

Special interest attaches to the recommendations of the Whaling Committee, in view of the recent great expansion of the industry, especially in the Antarctic. The Committee expressed the view that while investigations are not sufficiently advanced to enable definitive and adequate regulations to be framed for the conservation of the stock of whales, there are certain practical steps, for example, for the protection of young and immature whales, which might be taken at once by international agreement, and it asked the Council to impress this point of view upon the governments concerned. It proposed also the organisation of adequate statistics of the catch of whales in all parts of the world.

At last year's meeting the innovation was made of devoting two days to the discussion of subjects of general scientific interest affecting the Council's work, and the same useful plan was adopted at the present meeting. The subjects chosen for discussion on this occasion were "Fluctuations in the Age Classes of Fishes," and "Current Measurements, Direct and Indirect." No fewer than twenty communications were read on the former subject, and as there was no time for discussion it was arranged that the papers should be published and debated at the next meeting of the Council The same procedure was adopted for the papers read on current measurements

On Tuesday and Wednesday, April 16 and 17, a joint meeting of the International Council and the Challenger Society was held at the Laboratory of the Marine Biological Association at Plymouth. Scientific exhibits were arranged by the staff of the Laboratory on the Tuesday, and on the following morning a discussion took place on the subjects considered at the special scientific meetings of last year, namely, "The Estimation of Phosphates and Nitrogenous Compounds in Sea Water" and "Racial Investigations of Fish" (see *Rapports et Procès Verbaux*, vols. 53 and 54, 1929) Prof H H Gran described the results of his work on diatom frequency in relation to phosphates and nitrates. He finds that while these salts decrease in proportion with increased frequency of diatoms, there are indications of some other unknown factor also at work. Dr. W. R G Atkins remarked on the necessity for observing the greatest caution in estimating phosphates, as the slightest trace of impurities renders the samples useless

The discussion on races in fish was then opened by Prof. E Ehrenbaum. In the discussion which followed, the majority of the speakers inclined to the view that the counting of variable characters such as vertebræ, etc., is more likely to show up the effect of local conditions than to demonstrate the existence of distinct races. Prof J. Hjort proposed that the meeting should send a message to Prof F. Heincke as a mark of respect for the great work he originated, many years ago, on the races of herring.

Meteorology in India.

WE have received the first three volumes of a new series of meteorological publications that is being issued by the India Meteorological Department, entitled "Scientific Notes" We suppose that this publication will correspond with the "Professional Notes" of the Meteorological Office, London, and if this be the case it will be valuable in that it will place on permanent record contributions to meteorology which, though not always of the first rank in importance, afford collectively a useful body of information, the reliability of which is to some extent vouched for by the issuing authority—in the case of the series under review, presumably the Director-General of Observatories in India The only serious drawback of publications of this kind, as compared with similar papers read before a scientific society, appears to be that no discussion of the validity of the conclusions is published with them and the general reader can form little idea, in those cases where novel views are brought forward, as to whether or no a definite advance has been made

The first 'note' is by Mohammad Ishaque. It is entitled "A Comparison of Upper and Gradient Winds at Agra and Bangalore" Here no novel opinions are put forward, but an unfortunate mistake in the statement of the motion of winds under balanced forces has been made in the introduction —a mistake that would immediately have been pointed out had the paper been read before a scientific audience—namely, that the ordinary 'gradient wind' equation does not hold at the equator, and therefore that the fairly good agreement found in temperate latitudes between the gradient wind and the actual wind at a height of 500 metres can scarcely be expected to hold in such a low latitude as that of Agra (27° N.) or at Bangalore (13° N) This is no mere verbal slip, the author did not mean 'geostrophic' wind instead of 'gradient' wind, for he states that in determining his theoretical 'balanced' wind the curvature of the isobars was taken into account.

Mr. Ishaque's results show an astonishingly poor agreement between the computed and observed winds. at Agra the correlation coefficient is only 0·34 for a height of 500 metres, and 0 39 for 1000 metres Sir Napier Shaw in his "Manual of Meteorology" quotes coefficients of about 0·7 and 0·8 for observations made in England. To an uncritical reader, noting these contradictory results and observing that the Indian meteorologist was careful to deal only with days on which the pressure gradient was apparently determinable, an important fact would appear to have been established, but when it is pointed out that in England, where the difficulties in the way of obtaining a close network of reliable observations of barometric pressure must be less than in India, determination of the pressure gradient, and from it the 'gradient-wind,' is impossible to do accurately, one is tempted to wonder whether the relative magnitude of the correlation coefficients in the two countries are not a measure simply of the point to which accuracy of measurement of barometric pressure has been carried in each case.

The second and third 'notes' are useful contributions of a straightforward kind, dealing respectively with the hourly rainfall of Madras over a long series of years and with an interesting type of thunderstorm—the 'nor'wester' of South Bengal. The nor'wester appears to be a thunderstorm of the line-squall type which yields hailstones of a size fortunately seldom encountered in Europe, but the maximum wind-speeds are more comparable with those of the European line-squall and rarely exceed 50 miles an hour. The storms are most frequent in April and May

University and Educational Intelligence.

CAMBRIDGE.—The Adams Prize for 1927–28 has been awarded to Prof. Sydney Chapman, professor of mathematics in the Imperial College of Science and Technology, London. The value of the prize is about £246. The subject set was "The Variations in the Earth's Magnetic Field in Relation to Electric Phenomena in the Upper Atmosphere and on the Earth."

DR. R. P. RAUP, professor of the philosophy of education in Teachers College, Columbia University, New York City, will deliver a lecture on May 8 at 6 P.M., on "The Psychological Basis of the 'Project Method,'" in the Library of the Central Hall, Westminster, S.W.1. Tickets (price 1*s.*) can be obtained from the secretary, New Education Fellowship, 11 Tavistock Square, W.C.1.

A SUMMER tour to Norway, leaving Newcastle on July 27, is being arranged by the Educational Travel Association. Shore excursions under competent guidance will be made for studies in the fiord region, and an extension overland will be made to the sub-arctic area of the tableland, and to Oslo for the ethnological exhibits of Eskimo life collected by Amundsen, and the geological, botanical, and archæological collections there. Particulars may be obtained by sending a 2*d.* stamp to the honorary secretary, E.T.A., c/o the Cheshire Training College, Crewe.

A SUMMER school of biology, under the direction of Prof. F. A. E. Crew, is being organised by the Education Committee for the County Borough of Brighton, to be held at the Municipal Training College on Aug. 2–16. Courses will be given on biology and the school curriculum (Prof. A. D. Peacock, University of St. Andrews, and Mr. G. B. Walsh, High School for Boys, Scarborough), on the theory of the cell, the gene, and organic inheritance in man (Prof. F. A. E. Crew), and there will be single lectures on special topics. Practical and field work is being arranged. Particulars can be obtained from the secretary to the Brighton Education Committee, Mr. F. H. Toyne, 54 Old Steine, Brighton.

PARTICULARS of vacation courses to be held in Great Britain in 1929 are given in a pamphlet recently issued by the Board of Education. There will be courses in science subjects in England and Wales as follows: arranged by the Board for teachers only—in physics at Cambridge and Harrow, in chemistry at Oxford, in biology at Cambridge, in engineering at Oxford, and in gas technology at Leeds; arranged by local education authorities—in chemistry at Nantwich, in biology at Brighton, Nantwich, and Bingley, in rural science at Barry (South Wales), in mining and engineering at Swansea, and in regional survey at Folkestone; organised by university bodies—in biology at Cambridge, Great Ayton (Yorks), and at or near Birmingham, in psychology at Cambridge, Oxford, Bristol, Rocester (Staffs), Chester, Bangor, and Harlech; organised by other bodies—in mine survey and economic geology at Camborne, in regional survey at Stratford-on-Avon, and in psychology of handwork at Chester. A novel course in mothercraft, organised by the Board for teachers in elementary schools, will be held in London on July 22–Aug. 2. Only three courses for foreigners are announced, to be held at Cambridge, London, and at Exeter. The Board has this year, for the first time, included in the pamphlet particulars of vacation courses in Scotland, namely, courses for teachers arranged by the National Committee for the Training of Teachers, and courses, planned to be completed in two summers, of the ordinary university degree standard, to be held at Edinburgh in mathematics, physics, geography, and biology.

Calendar of Patent Records.

May 6, 1845.—The introduction of the electric telegraph and its rapid progress were mainly due to the united efforts of Sir Charles Wheatstone and Sir William Fothergill Cooke, who, approaching the subject one from the scientific and the other from the business point of view, were brought together at a time when many attempts were being made to devise a practical system. Their first patent was taken out in 1837. But complete success was not achieved until they produced the single needle telegraph, which was patented by them on May 6, 1845. A special Act of Parliament was passed to permit the formation of a company of more than twelve persons (the maximum number allowed under the various grants) to work this and all the earlier patents of the two inventors.

May 7, 1794.—The first real gas engine was the invention of Robert Street, who patented it on May 7, 1794, under the title "A new invented method to produce an inflammable vapour-force by means of liquid, air, fire, and flame, for communicating motion to engines and machinery." In Street's engine, a few drops of spirit of turpentine are introduced into the cylinder, the bottom of which is kept heated so that the spirit is instantly converted into vapour. The piston is at the same time moved upwards, and a quantity of air thereby sucked into the cylinder, which mixes with the vapour and forms an explosive mixture which is ignited by a flame applied to a touch-hole.

May 7, 1802.—The corkscrew now in common use in which the prong is fixed to the end of a right-handed screw which works in a hollow quick left-handed screw working in a hollow cylinder shaped to fit over the bottle mouth, so that the cork is pierced and extracted by one continuous right-handed turning of the handle, was patented by Sir Edward Thomason of Birmingham on May 7, 1802. During the term of the patent more than 130,000 corkscrews of this type were made at prices ranging from one guinea to four shillings.

May 9, 1807.—Sir William Cubitt's invention for automatically varying the area of sail in a windmill according to the strength of the wind was patented on May 9, 1807. Cubitt substituted movable shutters for the sail fabric, and geared the shutters to a rod running through the centre of the wind-shaft, so that the opening and closing movements of the shutters were communicated to the rod. A hanging weight attached to the end of the rod was adjusted to keep the shutters at the most suitable angle, but allowed them to open to present less effective surface to the wind when this became stronger than normal. This mechanism and the earlier invention of Andrew Meikle for automatically keeping the sails into the wind were extensively adopted and are still in use in England, but were not taken up on the Continent.

May 9, 1865.—The first application of hydraulic power for the operation of tools was Ralph Hart Tweddell's invention for fixing or tightening the ends of boiler tubes by means of expanding dies operated by hydraulic or other fluid pressure, which was patented on May 9, 1865. The invention was immediately successful and resulted in a reduction of more than one-fourth in the cost of riveting.

May 10, 1837.—The manufacture of galvanised iron is due to two Frenchmen, Ledru and Sorel, of Paris, who were granted a French patent for their invention on May 10, 1837, and followed this with twenty-three patents of improvement between that date and 1846. The English patent was sealed in the name of Craufurd in April 1837.

Societies and Academies.

LONDON.

Royal Meteorological Society, April 17.—The late W. H. Dines and L. H. G. Dines: Monthly mean values of radiation from various parts of the sky at Benson, Oxfordshire. Records for the five years 1922–1926 are given. The radiation is dealt with under two heads: (1) Luminous rays, (2) dark heat rays of wave-length exceeding about 2 μ; each is measured under conditions of (1) clear skies, (2) completely overcast skies.—L. H. G. Dines: An analysis of the changes of temperature with height in the stratosphere over the British Isles. The average temperature distribution in the stratosphere over the British Isles consists of a pronounced inversion of 3° C. at the bottom, followed by a lapse of about 0.5° C. per km. from (H_c+3) km. upwards to at least (H_c+8). There is no significant connexion between the magnitude of the inversion and either the lapse rate just below it, or the temperature in the troposphere in the layer $3\frac{1}{2}$ to $7\frac{1}{2}$ km. Such evidence as is available is against the existence of a diurnal variation of temperature in the stratosphere.—H. A. Hunt: A basis for seasonal forecasting in Australia. A fairly definite four-year cycle is indicated, consisting of two dry years followed by two wet years, and requiring two years to be allotted to the drying and heating phase and two to the wetting and cooling. The four-year period in the rainfall is also fairly well marked in the percentage of the continental area over which the rainfall is above the average each year.

PARIS.

Academy of Sciences, Mar. 25.—P. Villard: Associations and forms of clouds. Discussion of the relations between the forms of clouds and production of rain.—F. E. Fournier: A means of extending French trade.—Alex Véronnet: There are three distinct spaces and three only: Euclid, Riemann, and Cartan.—R. Chambaud: The deformation of arches.—J. H. Coblyn: Diagrams and monograms.—H. Weiss and E. Vellinger: The measurement of the interfacial tension between mineral oils and aqueous solutions. The influence of time and of the hydrogen ion concentration. The interfacial tension of a system mineral oil–aqueous solution of electrolyte depends not only on the hydrogen ion concentration of the aqueous phase but also on the nature of the electrolytes utilised. But the variations due to the nature of the electrolytes are negligible as a first approximation compared with those brought about by the variations of the hydrogen ion concentration.—F. Prevet: The influence of boric acid on the phosphorescence of zinc sulphides prepared by the explosion method. The phosphorescent zinc sulphide prepared with boric acid is unaffected by air and moisture. There is a marked increase in the luminosity of the product.—Pierre Leroux: Study of the absorption of a specimen of blue rock salt. A study of the variation of the absorption of blue rock salt as a function of the wave-length and of the temperature.—Jean Cabannes and Pierre Salvaire: The enlargement and displacement of the lines of the spectrum by molecular diffusion.—M. Ponte: Electronic analysis: lattice of the oxides of magnesium, zinc, and cadmium. The experimental results given permit of the conclusion being drawn that for the velocities of electrons utilised, electronic analysis is at least as accurate as analysis by X-rays, and may be used with confidence.—E. Sevin: The photoelectric effect and the continuous X-spectrum.—André Michel and Pierre Benazet: The reheating of austenitic steels.—Léon Lortie: The combinations of the salts of tetravalent cerium and of thorium with sodium carbonate (sodium cericarbonate and thoricarbonate). The ceric salt $Na_6Ce(CO_3)_5+12H_2O$ has been isolated in crystals. A thorium salt of analogous composition has also been isolated.—L. Jacqué: The fusibility of the ferro-calcium alloys.—R. Cornubert and Ch. Borrel: Anomalies of condensation and of cyclisation. Studies on the condensation products of α-methyl-α'-cyclopentanone and benzaldehyde in the presence of hydrochloric acid.—J. Bougault and Mlle. Bl. Leroy: Phenyloxymaleic anhydride. This substance gives crystallised compounds with amines, insoluble in ether, useful for the characterisation of the amines.—A. Demay: The antestephanian tectonic of the central French plateau to the east of the Loire.—René Bréon: Observations on beach deposits. In the bay of Authie pebbles and fragments of rocks are found which appear to have been transported at least 250-300 kilometres from the coast of the south of England. It is impossible for these to have been carried in suspension like sand, and the question as to the means of transportation is difficult of solution. One single specimen of rock had attached to it remains of *Fucus saccharinus*, and the author suggests that seaweed attached to the rocks may have been the cause of the flotation.—A. Vincent: The electrification of winds charged with snow. Winds charged with frozen snow caused the development of high potentials in an aerial capable of giving sparks up to 5 mm. in length.—Joseph Devaux: The measurement of the absorption factor of the surface of some Pyrenees glaciers for the solar radiations. If the surface of the glaciers consisted of pure ice limited by a plane surface, about 98 per cent would be absorbed. The absorption factors found were between 0.4 and 0.77, the lower value being undoubtedly due to the extensive alterations in the surface of the glaciers.—I. D. Streinikov: The ecological conditions of existence of the fauna of the Kara Sea.—C. Chabrolin: The decay of the inflorescence of the date palm (Khamedj). The author confirms the conclusions of Cavara that this disease is due to the parasite *Manginiella Scættæ*. The most practical treatment appears to be dusting the terminal bud with a mixture of powdered copper sulphate and slaked lime.—Jules Amar: Sex and nutrition.—Serge Yourievitch: The principal characters of the ocular movements. A summary of the results of a kinematographic study of more than 20,000 movements of the eye.—Jacques Pellegrin: The Cichlidæ of Madagascar.—E. Voisenet: New researches on the nature of the substance which produces the bitter taste in the disease of bitter wines. A description of the isolation of a very bitter substance, a derivative of acrolein, from 40 litres of wine attacked by the disease.—H. Colin and Marc Simonet: The viscous fermentation of the frozen beet. The viscous material is produced by a coccus at the expense of the sugar. The coccus has been isolated and cultivated. The viscous material appears to be identical with the dextrane previously isolated by various authors from sugar refinery juice contaminated with *Leuconostoc mesenteroides*.—Ducloux, Rinjard, and Mlle. Cordier: The symbiosis *in vivo* of the virus of Borrel's pustule in sheep and the virus of foot-and-mouth disease.

April 2.—A. Lacroix: A meteorite which fell at Beyrout (Syria) on Dec. 31, 1921.—L. Léger and O. Duboscq: *Harpella melusinæ*, an eccriniform entophyte parasite of the larvæ of *Simulium*.—J. A. Schouten: The geometrical significance of the semi-symmetrical property of an integral connexion which leaves the fundamental tensor invariant.—C. Bonnier: The determination of the

temperatures in explosion motors —Georges Mignonac and René Vanier de Saint-Aunay The polymerisation of acetylene by the silent discharge. The synthesis of dipropargyl and of its isomers The complicated mixture produced by the action of the silent discharge on acetylene consists partly of a primary condensation product due to the discharge alone and partly of the secondary polymerisation of this by heat By carrying out the reaction at $-60°$ C the hydrocarbons dipropargyl, methylpentadiine and a hexadiene were isolated —Pierre Bedos and Adrien Ruyer The dehydration of the oxide of cyclohexene and the passage from the C_6 ring to the C_5 ring Cyclohexene oxide can be dehydrated by phthalic anhydride giving 1 3-cyclohexadiene and this is generally accompanied with isomerisation of the oxide to cyclopentane aldehyde.—Paul Lemoine The superposition of a Tertiary anticline on a Cretaceous syncline

BRUSSELS

Royal Academy of Belgium, June 2 —G Cesaro The points of equal inertia of the rhombohedron.—Victor Willem The polarity of the locomotor apparatus of the actinians —Th De Donder The photonic field —Ad Mineur Left projective cubics —L. Van den Berghe Researches on deglutition in the teleostean fishes —Frans Halet The discovery of an eruptive mass in the subsoil of Grammont —L Godeaux The congruences formed by the Wilczynski lines of a surface —L Godeaux The surfaces having the same quadrics of Lie —G Van Lenberghe The calculation of the fugacities of a solution —R. H. J Germay The formula of Lagrange and its generalisation by M T J Stieltjes

Aug. 4 —A de Hemptinne The ionisation and chemical combination of gases —Lucien Godeaux. The congruences of Goursat and surfaces having the same Lie quadrics —J Jaumotte, E. Lahay, and J. F Cox An apparatus for the measurement of the magnetic inclination intended to be utilised by an aviator to determine his latitude The measurement is based on the electromotive force developed by a rotating coil, a null method being adopted in which the galvanometer, unsuitable for an aeroplane, is replaced by a telephone An accuracy of 10′ is indicated as possible, fixing the position in latitude within about 20 kilometres —P. Teilhard de Chardin Complementary note on the mammalian fauna of the lower Tertiary of Orsmael —M D V Jonesco A theorem of Lord Kelvin

CRACOW.

Academy of Science and Letters, Jan. 7 —T Banachiewicz. Auxiliary tables for the calculation of the selenographic co-ordinates.—T Banachiewicz: New methods for the correction of orbits —W. Lesnianski A method for the synthesis of acridone derivatives The use of phosphorus oxychloride as the condensing agent in the transformation of arylamine carboxylic acids into derivatives of acridone is advantageous, good yields being obtained —Mlle. E. Majdecka-Zdziarska *Galinsoga parviflora* and *Galinsoga hispida*. A discussion of the geographical distribution of these American species in Europe and in Poland, and of the question whether these should be considered as varieties or distinct species —Mlle C de Kleist Phyto-sociological researches on the peat bogs of the region of the dunes of the right bank of the Vistula in the neighbourhood of Warsaw —S Macko Researches on the geographical distribution and the biology of *Azalea pontica* in Poland —W Szafer. The element peculiar to the mountains in the flora of the Polish plain The geographical distribution of mountain plants in the plain leads to conclusions relating to the history of the migration of the plants during the diluvial period —M Thomaschewski Pollen analysis of the peat bogs of Kalmuzy and Pomerania —Z Woycicki The crystalloids in the nucleus and in the formations known as oleoplasts in *Ornithogalum caudatum* —R. J Wojtusiak Comparative studies of the larvæ of the genus *Mamestra* —S Karasinski Researches on the action of the antirachitic vitamin Rickets should be considered as a trouble of development, due to a complicated avitaminosis which can only be partly suppressed by the antirachitic factor.

Feb 4 —E. Zylinski A theorem of the theory of algebraic numbers —L Marchlewski and O. Wyrobek The absorption of the ultra-violet radiations by certain organic substances —L Marchlewski and A. Szymanski Researches on chlorophyll —P Mazák and J. Susko Researches on the oxosulphonic acids —K Dziewonski and A. Wulffsohn Researches on β-methylnaphthaline — B Hryniewiecki The geographical distribution of *Trapa* in Poland and contribution to the study of the varieties of this species —T. Wisniewski Associations of Bryophyta of Poland and especially of those of the virgin forest of Bialowieza —R Kobendza The flora of the fallen ground in the massif of Ste Croix —B F. Petschenko New and little known forms in the development of *Bacillus megatherium* and their cytology —St Smreczynski —Experimental researches on gastrulation in the batrachians —R. J Wojtusiak The orientation in space of the caterpillars of *Pieris* —W. Heinrich: The function of the capillaries and the fixation of the attention

LENINGRAD

Academy of Sciences (*Comptes rendus*, No 24, 1928) —S Borovik and Afanasjeva. Influence of a vacuum on the radium clock Some improvements in the Strutt radium clock are offered, and a method of making exact measurements with it of the pressure in relative vacua —A Lukašuk Helium in some thorium minerals of Russia The quantity of helium found in four minerals examined was as follows: chevkinite 0 109 c c, eshinite 0 648 c c, ortite 0 0638 c c, monatsit 0·287 c.c. in one gram of the mineral.—P. Svetlov Osmotic pressure and the permeability of membranes of trout eggs External membrane is permeable to electrolytes, organic molecules, and colloid particles. Osmotic pressure in the yolk of the eggs is constant throughout the period of development, so that some unknown mechanism for the regulation of the pressure must be present —B Stegmann A preliminary communication on an ornithological expedition in the upper and middle course of the Amur and in the western part of the Stanovoi ridge. Notes on distribution, nesting habits, etc, of a number of local bird species —C. Flerov Preliminary note on the diagnostic characters in the genus *Moschus* Linn. (Mammalia, Cervidæ) A brief review of musk-deers, containing diagnoses of five subspecies of *Moschus moschiferus* (including two new ones, namely, *arcticus*, from north-east Siberia, and *sachalinensis*, from Sakhalin Island), two subspecies of *M. chrysogaster*, and of a new species, *M berezovskii*, from the Sze-chuan province of China.

(*Comptes rendus*, No 25, 1928)—B Schtylko. Fossil remains of a pike from the Akmolinsk province The remains are those of a *dentale*, and their study showed no differences from the *Esox lucius*; and it may be suggested that the latter species existed already in the Pleistocene —A. Mordvilko *Geoica* Hart and its anolocyclic forms Plant-lice of the genus *Pemphigetum* Mordv, forming galls on *Pistachia* trees, proved to be able to migrate to roots of grasses, where they have been long known under the name

Geoica The *Geoica* root-form occurs in the areas where there are no *Pistachia* at present (North America), but it is possible to state definitely that the trees grew there in previous geological ages, with their disappearance only the grass-root form of the aphid remained —**G. Lindberg** Southern elements in the fish fauna of the Bay of Peter the Great (Sea of Japan). The fauna differs strikingly from that of the Okhotsk and the Bering Seas in its subtropical character, while including a number of typical Arctic forms, many of which, however, penetrate as far south as the Korean coasts At the same time, a number of southern forms are in their turn met with as far north as Vladivostok and Olga Bay

Melbourne.

Royal Society of Victoria, Dec 13 —**Edwin S Hills**. The geology and palæontology of the Cathedral Range and the Blue Hills, in North-Western Gippsland. This range is a double razorback composed of two beds of hard sandstone separated by softer shales and sandstones Although formerly believed to be Upper Palæozoic in age, they are overlain with a strong unconformity by Upper Devonian rhyolites, basalts, tuffs, and sediments outcropping to the east, and are apparently conformable with Upper Silurian sediments which outcrop to the west The Cathedral Beds have as yet yielded no fossils, but in the Upper Devonian rocks a new fish fauna was discovered.—**F. Chapman**. (1) On a fine example of the flanged cowrie, *Cypræa gastroplax* McCoy. The subgenus *Palliocypræa*, to which the species was referred by M Cossmann, is here given generic rank The shell structure is discussed —(2) On some trilobites and brachiopods from the Mount Isa District, North-West Queensland For many years these beds were referred to as schists of unknown age The rock in which the fossils are preserved is a cherty shale, horizontally bedded and found twelve miles west of Mount Isa at the head of the Templeton River The assemblage of fossils indicates a middle to upper Cambrian horizon —(3) On a new species of *Capulus* found attached to a *Pterygotus* carapace Some attached univalves, *Capulus melbournensis*, adherent to the counterpart of the Silurian *Pterygotus* somite which was described by McCoy in 1899. This palæozoic *Capulus* shows, in its habit and form, a close resemblance to the related tertiary genus *Hipponix*.

Vienna

Academy of Sciences, Jan 31 —**E Haschek** On Talbot's Law —**M Eisler** and **L Portheim** Further researches on the nicotine poisoning of fruits and seeds In *Nicotiana* and *Avena*, the alkaloid penetrates unhindered through the husk, in *Fagopyrum* with difficulty, in *Helianthus* scarcely at all The embryos are unequally resistant to nicotine. Calcium and potassium chlorides influence the degree of poisoning —**L Mirskaja** · Regenerative processes in growing points of *Tradescantia guianensis* —**M Holly** Some new African fish forms Species of *Barbus* from rivers

Feb 8 —**R Wegscheider** Reactions in light and in the dark with counter and following effects —**L. Moser** and **A. Brukl**. Determination and separation of rare metals from other metals (15) The quantitative analysis of gallium For separation of little gallium from much iron, sodium thiosulphate was used, this reduces ferric to ferrous and precipitates gallium.—**F. Staudinger** Heteromorphoses in stigmata and other organs of *Carausius morosus* —**H Burchardt** · Regeneration and symmetry of limbs stuck through the bodies of newts —**C. Zawisch-Ossenitz** The promotion of bone-growth by injection of bone extract

Feb 14 —**A Kailan** and **G Brunner** Velocity of esterification of alcohols in formic acid —**O Gugenberger** · The Brachiopoda of the Cardita strata at Launsdorf in Middle Carinthia —**O. Gugenberger** Upper Triassic Cephalopoda and Brachiopoda from Plakles on the Hohe Wand —**R E Mark** · Researches on the influence of various altitudes on the action of the thyroid gland in the dog —**K Federhofer** Graphical kinematics of a crank-loop oscillating in space

Official Publications Received.

British

Royal Photographic Society of Great Britain List of Honorary Fellows, Honorary Members, Fellows, Associates and Members, 1929 Pp 31 (London) 1*s*

Philosophical Transactions of the Royal Society of London Series B, Vol 217, No 446 Chromosome Linkage in certain Oenothera Hybrids By Prof R Ruggles Gates and F M L Sheffield Pp 367 394+plates 89-90 (London Harrison and Sons, Ltd)

Proceedings of the Royal Society of Queensland Vol 40, No 1 Presidential Address By Prof E J Goddard Pp 12 (Brisbane Anthony James Cumming)

Memoirs of the Department of Agriculture in India Botanical Series, Vol 17, No 1 Non dehiscence of Anthers in Punjab American Cottons By Trevor Trought Pp 5+2 plates (Calcutta Government of India Central Publication Branch) 4 annas, 5*d*

Memoirs of the Commonwealth Solar Observatory, Mount Stromlo, Canberra, Australia Memoir No 1 The Luminosity of the Night Sky observed with a Rayleigh Photometer at the Commonwealth Solar Observatory during the Years 1926 and 1927, by the Director and Staff, Pp 29 (Melbourne H J Green)

The Scientific Proceedings of the Royal Dublin Society Vol 19 (N S), No 16 The Integration of Light by Photo-electrolysis By Dr W R G Atkins and Dr H H Poole Pp 159-164 6*d* Vol 19 (N S), No 18 The Photo-electric Measurement of the Illumination in Buildings By Dr W R G Atkins and Dr H H Poole Pp 173-188 1*s* (Dublin Hodges, Figgis and Co, London Williams and Norgate, Ltd)

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1205 (Ae 366) Full Scale Tests of Bristol Fighter Aeroplane with R A F 30 Wings, fitted with "Pilot Planes" at the Wing Tips (T 2666) Pp 4+2 plates 4*d* net No 1173 (Ae 337) Full Scale Determination of the Effect of High Tip Speeds on the Performance of an Airscrew By W G Jennings (T 2655) Pp 10+8 plates 9*d* net (London H M Stationery Office)

Commission of Inquiry into the Holborn Explosions and Fires Report of the Commissioners appointed by the Home Secretary to inquire into the Circumstances of the Series of Explosions and Fires which occurred on the 20th and 21st December 1928 in the neighbourhood of New Oxford Street (Cmd 3306) Pp 54+4 plates (London H M Stationery Office) 1*s* 6*d* net

Third Report of the Committee appointed by Viscount Peel to consider the Establishment of Bird Sanctuaries in the Royal Parks in Scotland Pp 6 (Edinburgh and London H M Stationery Office) 6*d* net

Nyasaland Protectorate Geological Survey Water Supply Paper No 3 Weirs, Dams and Reservoirs for Estate Purposes By Dr F Dixey Pp 12 Annual Report of the Geological Survey Department for the Year 1928 Pp 22 (Zomba)

Union of South Africa Department of Agriculture Division of Chemistry Series, No 92 Manuring of Wattles, by C O Williams, and Fertilizer Trials with Wattles, by J B Osborn Pp 10 (Pretoria Government Printing Office)

Colony and Protectorate of Kenya Agricultural Census Ninth Annual Report, 1928 Pp 55 (Nairobi Department of Agriculture)

Trinidad and Tobago Department of Agriculture Administration Report of the Director of Agriculture for the Year 1927 Pp. 42 (Trinidad, B W I Government Printing Office, Port-of-Spain) 1*s* 6*d*

Journal of the Royal Microscopical Society Series 3, Vol 49, Part 1, March Pp xvi+90 (London) 10*s* net

Imperial Chemical Industries, Ltd Annual Report for the Year 1928 Pp 18 (London)

Royal Astronomical Society List of Fellows and Associates, March 1929 Pp 54 (London)

Ministry of Health General Circular on the Local Government Act, 1929 Pp 14 (London H M Stationery Office) 3*d* net

Ministry of Health Advisory Committee on Water Report on Rural Water Supplies Pp 38 (London H M Stationery Office) 9*d* net

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1165 (Ae 329) Wind Tunnel Experiments on the Design of an Automatic Slot for R A F 28 Section, and on Interconnection with Ailerons By F B Bradfield and K W Clark (T 2625 a b c) Pp 20+13 plates 1*s* net No 1181 (Ae 345) Instrumental Records of the Lateral Motions of a Stalled Bristol Fighter Aeroplane By Prof B. Melvill Jones and Flight-Lieut C E Maitland (T 2657) Pp 11+22 plates 1*s* net No 1186 (Ae 348) Wind Tunnel Tests of various Servo Rudder Systems By K V Wright (T 2630) Pp 17+10 plates 1*s* [illegible] mat[illegible] Pp [illegible] of an Aeroplane beyond the Stall By H M Garner and K V Wright (T 2727) Pp 6 4*d* net No 1198 (Ae 359) Wind Tunnel Tests with High Tip Speed Airscrews The Characteristics of a Conventional Airscrew Section, 0 082c Thick, and of R A F 27 and R A F 28 By Dr G P Douglas and W G A Perring (T 2631) Pp 4+5 plates 1*s*. net No 1202 (Ae 363) Determination of the Twist of a Wing of an Aeroplane in Flight By W G Jennings (T 2665) Pp 5+1 plate 6*d* net (London H M. Stationery Office)

Proceedings of the Royal Society Series A, Vol 123, No A792, April 6 Pp 373-736 + plates 18-22 (London Harrison and Sons, Ltd) 12s

The Proceedings of the Physical Society Vol 41, Part 3, No 228, April 15 Pp iv+181-230 (London) 7s net

Judicial Statistics, England and Wales, 1927 Criminal Statistics Statistics relating to Criminal Proceedings, Police, Coroners, Prisons and Criminal Lunatics for the Year 1927 (Cmd 3301) Pp xxiii+13 229 (London H M Stationery Office) 4s net

Reports of the Council and Auditors of the Zoological Society of London for the Year 1928, prepared for the Annual General Meeting to be held at the Society's Offices in Regent's Park, on Monday, April 29th, 1929, at 4 p m Pp 87 (London)

Report of the Rugby School Natural History Society for the Year 1928 (Sixty-second Issue) Pp 40+2 plates (Rugby)

Brackenhill Open-Air Home School, Hartfield, near Tunbridge Wells Annual Report, September 1927 to August 1928 Pp 16 (Hartfield)

FOREIGN.

Proceedings of the American Academy of Arts and Sciences Vol 63, No 9 Thermo-electric Phenomena and Electrical Resistance in Single Metal Crystals By P W Bridgman Pp 351-399 90 cents Vol 63, No 10 The Effect of Pressure on the Rigidity of Steel and several varieties of Glass By P W Bridgman Pp 401 420 45 cents Vol 63, No 11 Tables of Lagrangean Coefficients for Interpolating without Differences By Edward V Huntington Pp 421 437 45 cents (Boston, Mass)

Proceedings of the United States National Museum Vol 73, Art 15 Contribution to the Comparative Anatomy of the Eared and Earless Seals (Genera Zalophus and Phoca) By A Brazier Howell (No 2736) Pp 142+1 plate Vol 74, Art 14 New Fossil Mollusks from the Miocene of Virginia and North Carolina, with a Brief Outline of the Divisions of the Chesapeake Group By Wendell C Mansfield (No 2759) Pp 11+5 plates Vol 74, Art 23 Mineralogy and Geology of Cerro Mercado, Durango, Mexico By William F Foshag (No 2768) Pp 27+4 plates Vol 74, Art 26 The Gums of the Porpoise Phocoenoides Dalli (True) By Gerrit S Miller, Jr (No 2771) Pp 4+4 plates (Washington, D C Government Printing Office)

Department of Commerce Bureau of Standards Bureau of Standards Journal of Research, Vol 2, No 2, February R P No 38 A Technical Method of Using the Mercury Arc to obtain Data at Wave Length 560 mμ in the Spectrophotometric Analysis of Sugar Products, by H H Peters and F P Phelps, R P No 39 Reflecting Power of Beryllium, Chromium, and several other Metals, by W W Coblentz and R Stair, R P No 40 Note on a Piezo-electric Generator for Audio-frequencies, by August Hund, R P No 41 Heats of Combustion of Organic Compounds, by M S Kharasch, R P No 42 Laboratory Corrosion Tests of Mild Steel, with special reference to Ship Plate, by Henry S Rawdon, R P No 43 Least Retinal Illumination by Spectral Light required to evoke the "Blue Arcs of the Retina," by Deane B Judd, R P No 44 The Service of Refractory Blocks in a small Experimental Glass Tank, by W L Pendergast and Herbert Insley Pp 335 465+10 plates (Washington, D C Government Printing Office)

Académie Tcheque des Sciences (Česka Akademie Věd a Umění) Bulletin International Resumés des travaux presentes, Classe des Sciences mathematiques, naturelles et de la medecine 27e annee (1926) Pp v+628 (Prague)

Sveriges Geologiska Undersokning Ser Aa, No 121 Beskrivning till kartbladet Skovde Av Henr Munthe, A H Westergård och G Lundquist Pp 182+2 tavlor 4 00 kr Ser Aa, No 158 Beskrivning till kartbladet Valdemarsvik Av R Sandegren och N Sundius Pp 70+1 tavla 4 00 kr Ser Aa, No 159 Beskrivning till kartbladet Gusum. Av Bror Asklund, Gunnar Ekstrom och Gunnar Assarsson Pp 107+1 tavla 4 00 kr Ser Aa, No 165 Beskrivning till kartbladet Filipstad Av Nils H Magnusson och Erik Granlund Pp 119+1 tavla 4 00 kr Ser Aa, No 169 Beskrivning till kartbladet Slite Av Henr Munthe, J Ernhold Hede och G Lundquist Pp 130+1 tavla 4 00 kr (Stockholm)

Department of Commerce Bureau of Standards Bureau of Standards Journal of Research Vol 2, No 3, March R P 45 Apparatus and Methods for the Separation, Identification and Determination of the Chemical Constituents of Petroleum, by Edward Washburn, Johannes H Bruun and Mildred M Hicks, R P No 46 Recombination Spectra of Ions and Electrons in Cæsium and Helium, by F L Mohler and C Boeckner, R P No 47 The Spectral Absorption of certain Monoazo Dyes, 1 The Effect of Position Isomerism on the Spectral Absorption of Methyl Derivatives of Benzeneazophenol, by Wallace R Brode, R P No 48 Transmission of Sound through Wall and Floor Structures, by V L Chrisler and W F Snyder, R P No 49 Discharge Coefficients of Square-edged Orifices for Measuring the Flow of Air, by H S Bean, E Buckingham and P S Murphy Pp 467-658+8 plates (Washington, D C Government Printing Office)

Bulletins of the Pacific Scientific Fishery Research Station Vol 2, Part 3 Some Observations on the Spawning of the Amour and Kamchatka Salmons By I I Kusnetzow Pp 196 In Russian, with Summary in English 3 rub 75 kop Vol 2, Part 4 Materials of the Land Flora of the Shantar Islands By I K Shishkin Pp 48 In Russian, with Summary in English 75 kop Vol 2, Part 5 Mammals of the Shantar Islands By Prof S I Ognew Pp 43 In Russian, with Summary in English 60 kop (Vladivostock)

Proceedings of the Imperial Academy Vol 5, No 2, February Pp iii-iv+57-102 (Tokyo)

Japanese Journal of Astronomy and Geophysics Transactions and Abstracts Vol 6, No 2 Pp 71-142+4 plates (Tokyo National Research Council of Japan)

Proceedings of the California Academy of Sciences, Fourth Series Vol 18, No 4 Marine Miocene and related Deposits of North Colombia By Frank M Anderson Pp 73-213+plates 8 23 (San Francisco)

Proceedings of the United States National Museum Vol 74, Art 16 A Revision of the North American Ichneumon-Flies of the Genus Mesostenus and related Genera By R A Cushman (No 2761) Pp 58 Vol 75, Art 7 A Revision of the American Two winged Flies of the Psychodid Subfamily Bruchomyinae By Charles P Alexander (No 2778) Pp 9 (Washington, D C Government Printing Office)

List of Publications of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, 1928 Pp 9 (Washington, D C Carnegie Institution)

Proceedings of the California Academy of Sciences Fourth Series Vol 18, Nos 5, 6, 7, 8 No 5 A New Pecten from the San Diego Pliocene, by Leo George Hertlein, No 6 A New Species of Land Snail from Kern County, California, by G Dallas Hanna, No 7 A New Species of Land Snail from Coahuila, Mexico, by G Dallas Hanna and Leo George Hertlein, No 8 Some Notes on Oreohelix, by Junius Henderson Pp 215 227+plate 24 Vol 18, No 9 Notes on the Northern Elephant Seal By M E McLellan Davidson Pp 229 243+plates 25-26 Vol 18, No 10 On a Small Collection of Birds from Torres Strait Islands, and from Guadalcanal Island, Solomon Group By M E McLellan Davidson Pp 245-260 Vol 18, No 11 The Generic Relationships and Nomenclature of the California Sardine By Carl L Hubbs Pp 261-265 (San Francisco)

Department of the Interior Bureau of Education Bulletin, 1928, No 23 Record of Current Educational Publications, comprising Publications received by the Bureau of Education, October-December 1927, with Index for the Year 1927 Pp 116 (Washington, D C Government Printing Office) 20 cents

CATALOGUES

Getting the Most out of Radio Pp 184 (Liverpool Claude Lyons, Ltd)

Clarostat a Brief Survey of their Applications in the Science of Radio Third edition, revised and enlarged Pp 24 (Liverpool Claude Lyons, Ltd)

Concerning High Frequency Stabilisation by Piezo Electric Oscillators Pp 12 (London Adam Hilger, Ltd)

Spectroscopy in Control of Purity in Food Stuffs Pp 7 (London Adam Hilger, Ltd)

Diary of Societies.

FRIDAY, MAY 3

IRON AND STEEL INSTITUTE (Annual Meeting) (at Institution of Civil Engineers), at 10 A M —Announcement of the award of the Andrew Carnegie Research Scholarships for 1929-30 —Presentation of the Carnegie Gold Medal to Dr A Bramley —The Hon Sir Charles Parsons and H M Duncan A New Method for the Production of Sound Steel —Third Report on Heterogeneity of Steel Ingots, by a Committee of the Institute —J. M Robertson The Microstructure of Rapidly Cooled Steel —D Lewis The Transformation of Austenite into Martensite in a 0 8 per cent Carbon Steel —A L Norbury Constitutional Diagrams for Cast Irons and Quenched Steels —At 2 30 —G R Bolsover Brittleness in Mild Steel —L B Pfeil The Oxidation of Iron and Steel at High Temperatures —E G Herbert and P Whitaker The Differential Method for Measuring the Thickness of Hard Cases without Sectioning them —T E Rooney and G Barr A Method for the Estimation of Hydrogen in Steel

ROYAL SOCIETY OF MEDICINE (Otology Section) (Annual General Meeting), at 10 30 A M —The Treatment of Chronic Deafness —Dr D McKenzie The Symptomatic Treatment of Deafness —H Kisch Chronic Deafness, its Treatment and Prevention —T Neville Chronic Deafness —G S Hett and A G Wells Ionisation as a Treatment for Middle-ear Suppuration

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4 30 —Cloud Formation C J P Cave, Sir Gilbert Walker Chairman, Sir Frank Dyson

ROYAL SOCIETY OF MEDICINE (Laryngology Section) (Annual General Meeting), at 5 —F J Cleminson Treatment of Carcinoma of the Œsophagus by Radium

PHILOLOGICAL SOCIETY (at University College), at 5 30 —Anniversary Meeting

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7 —G D Malcolm Chairman's Address

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7 — H Berry London's Water

GEOLOGISTS' ASSOCIATION (at University College), at 7 30 —Dr S W Wooldridge and A J Bull The Arun Gap and Lower Greensand around Pulborough

INSTITUTION OF AUTOMOBILE ENGINEERS (jointly with Institution of Production Engineers) (at Royal Society of Arts), at 7 45 —H F L Orcutt The Production and Application of Ground Gears (Lecture)

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section) (Annual General Meeting), at 8 30 —Dr H Sington Pre medication by Paraldehyde in Children

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Sir Daniel Hall The Garden Tulip

SATURDAY, MAY 4

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Eastern District) (at Red Lion Hotel, Cromer), at 1

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Eastern District) (at Aerodrome Hotel, Croydon), at 2 15 —G A Ballard Town Planning and Municipal Airports

MONDAY, MAY 6

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Botany School), at 4 30 —A H K Petrie On the Ionic Equilibria of Plant Tissues —R G Tomkins Mould Growth and Atmospheric Humidity —R D Whyte The Cytological Basis of Partial Diœcism in Plants —*Papers to be communicated by title only* —C Pellew The Genetics of Unlike Reciprocal Hybrids —A F Shull Determination of Types of Individuals in Aphids, Rotifers, and Cladocera —J A Bierens de Haan Animal Language and its Relation to that of Man —G Koller Internal Secretions in Invertebrate Animals

ROYAL SOCIETY OF EDINBURGH, at 4 30 —G N Hunter Colour Sensitivity —Dr E B Ludlam and R B Mooney The Influence of Air and Moisture on the Budde Effect in Bromine —A C Stephen Studies on the Scottish Marine Fauna The Fauna of the Sandy and Muddy Areas of the Tidal Zone —George Redington Study of the Effect of Diurnal Periodicity upon Plant Growth —Dr Margery Knight Studies in the Ectocarpaceæ II Life-History and Cytology of *Ectocarpus siliculosus* Dillw —*To be read by title only* —Miss Mary H Latham Jurassic and Kainozoic Corals from Somaliland —Dr S Goldstein On the Asymptotic Expansion of the Characteristic Numbers of the Mathieu Equation

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4 30 —Rev Canon A Lukyn Williams Early Anti-Judaica—the Books of Testimonies

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5 —Dr G C Simpson The Importance of Climatic Stations in Polar Regions

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 —General Meeting

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6 —Dr R B Raup Is there a Psychology for Modern Education?

RAILWAY CLUB (at 57 Fetter Lane), at 7 30 —D D Barrie A Thirty Years' Survey

ROYAL SOCIETY OF ARTS, at 8 —Sir E Denison Ross Nomadic Movements in Asia (Cantor Lectures) (IV)

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8 —Dr T Moran Recent Advances in the Low-temperature Preservation of Foodstuffs

SURVEYORS' INSTITUTION, at 8 —H F Bidder and W V Graham Rights in Underground Water

TUESDAY, MAY 7

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5 30 —Annual General Meeting

ZOOLOGICAL SOCIETY OF LONDON, at 5 30 —Major S S Flower Exhibition of the Centenary Edition of the Vertebrate List Vol 1, Mammals —F. Martin Duncan Exhibition of Cinematograph Films of North American Big Game presented to the Society by Mr Prentiss N Gray —E B Worthington New Species of Fish from the Albert Nyanza and Lake Kioga —W Rowan A Hermaphrodite Spiny Dogfish (*Squalus suckleii*)

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E C), at 6 30 —T J Evans Life in the Deep Sea

INSTITUTE OF MARINE ENGINEERS, at 6 30 —W J Muller Notes on the Lentz Standard Marine Engine as Fitted to Ships of the Koninklijke Paketvaart Maatschappy (Royal Packet Line), Amsterdam

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7

INSTITUTE OF METALS (at Institution of Mechanical Engineers), at 8 —Sir Oliver Lodge Some Ideas about Metals (Annual May Lecture)

TELEVISION SOCIETY (at Engineers' Club, Coventry Street), at 8 —Capt R Wilson and A A Waters Some Practical Considerations in the Building of Television Apparatus —Demonstrations —Model Showing Mechanical Exploring as the Speed of the Disc Increases from Zero, R R Poole —Model of "Talking Film" Projector, H S Ryland

WEDNESDAY, MAY 8

ROYAL SOCIETY OF MEDICINE (Surgery Sub-Section of Proctology) (Annual General Meeting), at 4 45 —At 5 —Discussion on Fistula-in-ano

GEOLOGICAL SOCIETY OF LONDON, at 5 30 —F M Trotter The Glaciation of Eastern Edenside, the Alston Block, and the Carlisle Plain —J A Douglas A Marine Triassic Fauna from Eastern Persia

ROYAL SOCIETY OF ARTS, at 8

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8 15 —Dr H C Cocks Some Possible Uses of Alternating Currents in Electrodeposition

INSTITUTION OF CHEMICAL ENGINEERS (jointly with Institute of Fuel) —Discussion on The Scope of the Chemical Engineer in Relation to the Fuel Consuming Industries

THURSDAY, MAY 9

ROYAL SOCIETY, at 4 30 —R H Fowler and Dr P Kapitza Magnetostriction and the Phenomena of the Curie Point —Prof C G Darwin A Collision Problem in the Wave Mechanics —J A Gaunt The Relativistic Theory of an Atom with many Electrons —R de L Kronig The Quantum Theory of Dispersion in Metallic Conductors.—*Papers to be read by title only* —F J Wilkins The Kinetics of the Oxidation of Copper Part I —C E Eddy, Prof T H Laby, and A H Turner Analysis by X Ray Spectroscopy —M C Johnson The Adsorption of Hydrogen on the Surface of an Electrodeless Discharge Tube —A Elliott The Absorption Band Spectrum of Chlorine —H W Thompson and C N Hinshelwood The Influence of Nitrogen Peroxide on the Combination of Hydrogen and Oxygen —H J Phelps and R A Peters The Influence of Hydrogen Ion Concentration on the Absorption of Weak Electrolytes by Pure Charcoals —Dr H T Flint The First and Second Order Equations of the Quantum Theory —S Bhagavantam The Magnetic Anistropy of Naphthalene Crystals —A H Wilson Perturbation Theory in Quantum Mechanics II —C G Lyons and Dr E K Rideal On the Stability of Unimolecular Films Parts I, II, and III —P A M Dirac Quantum Mechanics of Many-Electron Systems —Prof O W Richardson and P M Davidson The Spectrum of H_2 The Bands Analogous to the Parhelium Line Spectrum Parts III and IV —H E Hurst The Suspension of Sand in Water —D Brunt The Transfer of Heat by Radiation and Turbulence in the Lower Atmosphere —R K Asundi The Third Positive Carbon and Associated Bands —Prof G I Taylor The Criterion for Turbulence in Curved Pipes —W G Bickley Hydrodynamic Forces acting on a Cylinder in Motion, and the Idea of a 'Hydrodynamic Centre' —M L E Oliphant The Action of Metastable Atoms of Helium on a Metal Surface —J Hargreaves The Effect of a Nuclear Spin on the Optical Spectra —Prof M N Saha and Ramash Chandra New Methods in Statistical Mechanics —N F Mott The Interpretation of the Wave Equation for Two Electrons

INSTITUTE OF PATHOLOGY AND RESEARCH (St Mary's Hospital, W 2), at 5 —Dr E D Adrian The Nervous Mechanism of Sensation and Movement

INSTITUTION OF ELECTRICAL ENGINEERS, at 6 —Annual General Meeting

IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7 —Discussion on A New Method for the Production of Sound Steel, by the Hon Sir Charles Parsons and H M Duncan —Third Report on Heterogeneity of Steel Ingots, by a Committee of the Institute —First Report on Blast-Furnace Plant and Practice, by a Committee of the Institute —Twenty Months' Results of Dry-Blast Operation, by E H Lewis —The A I B Sinter Plant at Messrs Guest, Keen and Nettlefolds, Ltd, Cardiff Works, by W E Simons

OIL AND COLOUR CHEMISTS' ASSOCIATION (at 30 Russell Square), at 7 —F Fancutt Painting as it Affects the Railways

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group), at 7

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7 30 —T H Court and Dr M von Rohr Contributions to the History of the Spectacle Makers' Company (Second Paper on the Court Collection)

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8 30 —Annual General Meeting

FRIDAY, MAY 10

ROYAL ASTRONOMICAL SOCIETY, at 5 —Prof E Hertzsprung The Pleiades (George Darwin Lecture) —E A Kreiken On the Dwarf Nature of Double Stars

PHYSICAL SOCIETY (at Imperial College of Science), at 5 —Dr W E Sumpner Heaviside's Fractional Differentiator —J H Awbery A Simple Method of Fitting a Straight Line to a Series of Observations —E W H Selwyn Arc Spectra in the Region λ1600-λ2100 —Dr K R Rao The Spectrum of Trebly ionised Thallium —G A Wedgwood The Elastic Properties of Thick Cylindrical Shells under Internal Pressure —A Demonstration relating to Standards of Length and Mass, by J E Sears

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (at Abbey Hotel, Kenilworth), at 5 30 —Discussion on Stare Bridge, D H Brown, Kenilworth Castle and Town, S Douglas

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5 30 —Annual General Meeting

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6

ROYAL SOCIETY OF ARTS (Indian Meeting), at 8 —Captain P Johnston-Saint An Outline of the History of Medicine in India (Sir George Birdwood Memorial Lecture)

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Prof A E Boycott The Twist of Snail Shells

SATURDAY, MAY 11

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Wales District) (at Council Chamber, Swansea), at 4 15 —Discussion on Some Road and Other Schemes at Swansea, R Hudson, Swansea Main Drainage Scheme and Flood Relief Schemes, J Hassall, Llansamlet Sewage Pumping Scheme, Swansea, M E Habershon

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Sections) (at Harrogate)

PUBLIC LECTURES.

FRIDAY, MAY 3

UNIVERSITY COLLEGE, at 4 —Prof A J Hall Some of the Sequels of Epidemic Encephalitis (Lethargica) —At 5 30 (Succeeding Lecture on May 10)—Prof R Robinson Public Inaugural Lecture

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5 30 —Prof F O Bower The Origin of a Land Flora reviewed 21 Years after Publication (Huxley Memorial Lecture)

TUESDAY, MAY 7

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY—ROYAL SCHOOL OF MINES, at 5 30 —Prof E de Margerie Some Aspects of French Tectonics (Succeeding Lectures on May 10 and 13)

INSTITUTE OF METALS (at Institution of Mechanical Engineers), at 8 —Sir Oliver Lodge Some Ideas about Metals (Annual May Lecture)

WEDNESDAY, MAY 8

UNIVERSITY OF BIRMINGHAM, at 4 30 —Dr C Singer Medicine and the Revival of Learning

CONGRESSES.

MAY 6 TO 11

INTERNATIONAL CONGRESS OF MILITARY MEDICINE AND PHARMACY (in London) —Subjects to be discussed —The Evacuation of Sick and Wounded by Air and Water, Tropical Fevers of Short Duration, Injuries to Blood-vessels and their Sequelæ, Physical and Chemical Analysis of the Glass and Rubber Articles Employed by the Medical Services, The Standard of Dental and Physical Fitness in the Various Military Services

MAY 15 TO MAY 20

ROYAL INSTITUTE OF PUBLIC HEALTH CONGRESS (at Zurich)

Section I —State Medicine and Municipal Social Hygiene
Section II —Industrial Hygiene and Industrial Diseases
Section III —Child Welfare, School Hygiene, and Women and Public Health
Section IV —Pathology, Bacteriology, and Biochemistry
Section V —Tuberculosis
Section VI —Climatology and Sports Hygiene
Section VII —Veterinary Medicine and Meat Hygiene

MAY 15 TO MAY 23

WORLD POWER CONFERENCE ON COMPLETE UTILISATION OF WATER POWER RESOURCES (at Barcelona) —Subjects to be dealt with —General Hydrological Problems, Technical Problems of Water Power Utilisation, Economic and Financial Problems, Legal Problems, Protective Measures and Defence Works of Undertakings

SATURDAY, MAY 11, 1929.

CONTENTS.

Editorial and Publishing Offices

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A Royal Commission on the Civil Service.

AT the last meeting of the National Whitley Council for the Civil Service, the staff side, at the instance of the Institution of Professional Civil Servants, moved for the appointment of a joint committee of the Council in the following terms:

> That a joint committee be appointed to inquire into the recruitment, organisation, duties, and pay of the professional, scientific, and technical Civil Servants employed in the scientific, research, and experimental branches of the Public Service, and to make recommendations

In reply, the official side of the Council, speaking on behalf of the Government, stated that while the motion for such a committee could not be accepted, the Government had decided to set up an inquiry into the organisation and lay-out of the research departments, upon which persons outside the Civil Service familiar with the problems involved would be invited to serve The Institution, while not satisfied that the views of the staffs it represented would be adequately considered by such an inquiry, decided to await further information before settling the policy it should adopt, and to call an early meeting of the standing joint committee of the Institution and the Association of Scientific Workers.

Two days after the meeting of the National Whitley Council, the Prime Minister unexpectedly announced to a women's deputation, not primarily concerned with Civil Service questions, that if returned to power the Government had decided to set up a Royal Commission on the Civil Service, with, it appears, wide terms of reference which would permit of a radical re-examination of the structure and organisation of the Service. This announcement was received with surprise in official circles, and it was thought in some quarters that the Royal Commission would, in view of the character of its proposed reference, take within its scope the inquiry concerning the research departments. The Institution has made inquiries through the staff side of the National Whitley Council, and learns that two separate inquiries are in fact intended.

It is all to the good that the special problem of the organisation of research under the auspices of the State should receive expert and impartial consideration The recent Report of the Research Co-ordination Sub-Committee of the Committee of Civil Research indicated that there was scope for closer co-ordination in certain directions, and better organisation and concentration of control

should lead to a higher status for the research departments, and so to better conditions for the scientific staffs, which lag far behind those of non-scientific civil servants. But it is to be hoped that the Royal Commission will be so constituted as to ensure that, in the consideration of the structure of the Civil Service, due regard will be paid to the views of those who hold that science is an integral part of the life of civilised communities, and that economical administration requires a full recognition of the contribution that the technical expert in the wide sense can make towards the promotion of social welfare In the Civil Service the technical expert has little or no authority and is normally regarded as a mere consultant, with the result that his career and status are adjusted accordingly. The control of the Service by a close caste of administrators, few of whom have received an advanced scientific training, has inevitable reactions on the part that the man of science, whether pure or applied, is permitted to play in administration. Status in the Civil Service, as elsewhere, is reflected in remuneration, and Sir Richard Redmayne has recently pointed out in his presidential address to the Institution of Professional Civil Servants that the highest scientific posts in the Service carry half the salary of the highest administrative posts

The modern State cannot afford to treat in this fashion those upon whom material progress depends. Efficiency of the administrative machine must depend upon a ready acceptance of the results of research and appreciation of the need for the scientific approach in the solution of administrative problems A Royal Commission which does not include a number of scientific and professional men of acknowledged authority and experienced in the application of scientific method and discovery to administrative necessities will inevitably produce a report highly coloured by traditional ‘establishment’ notions in the Civil Service, which will rivet upon the Service for yet another generation a system of control now some two generations old and completely out of touch with modern necessities Mr. Churchill, in reply to a parliamentary question, has stated that the object of the Royal Commission is to undertake “a dispassionate and informed examination of the Civil Service from the point of view of its efficiency as a national instrument and of its own well-being”. These words are admirable, but we shall await with interest the actual terms of reference, and above all the actual personnel of the Commission.

Rays and Waves.

(1) *Handbuch der Experimentalphysik* Herausgegeben von W Wien und F Harms. Unter Mitarbeit von H Lenz Band 15 *Radioaktivitat.* Von Prof. K. W. F. Kohlrausch. Pp. xii + 985. 81 gold marks (2) Band 18 *Wellenoptik und Polarisation* Bearbeitet von K. F. Bottlinger, R Ladenburg, M v Laue, Hans Schulz. *Photochemie*, von E Warburg Pp. xiv + 674 63 50 gold marks (3) Band 19: *Dispersion und Absorption* Von Prof George Jaffé *Medien mit veranderlichem Brechungsindex und Lichtzerstreuung* Von Prof Richard Gans. Pp viii + 430. 41 gold marks. (4) Band 23: *Phosphoreszenz und Fluoreszenz.* Teil 1. Von P. Lenard, Ferd. Schmidt und R Tomaschek. Pp xxiii + 741 71 gold marks. (5) Band 23: *Phosphoreszenz und Fluoreszenz.* Teil 2. Von P Lenard, Ferd. Schmidt und R. Tomaschek. *Lichtelektrische Wirkung* Von P. Lenard und A. Becker Pp xi + 745-1544 72 gold marks. (Leipzig Akademische Verlagsgesellschaft m b H, 1928)

TO the third book of Newton's “Opticks” are appended certain famous Queries, some of which are as applicable to-day as when they were first written In Query 17 he asks: “When a ray of light falls upon the surface of any pellucid body, and is there refracted or reflected, may not waves of vibrations, or tremors, be thereby excited in the refracting or reflecting medium at the point of incidence, and continue to arise there, and to be propagated from thence as long as they continue to arise and be propagated . . . ? and are not these vibrations propagated from the point of incidence to great distances ? and do they not overtake the rays of light, and by overtaking them successively, do they not put them into the fits of easy reflexion and easy transmission described above ? ”

In these days when waves of light pose as corpuscles or quanta, and material particles assume the characteristics of waves (albeit waves in space of many dimensions), the whole of modern physics might be included in the two terms ‘rays’ and ‘waves’. But these volumes of the monumental “Handbuch der Experimentalphysik” are more particularly concerned with light waves and the rays from radioactive substances, and there is no danger of misunderstanding when they are summarised under these two headings. At the same time, the dilemma which confronts the physicist is reflected in the treatment meted out to the quantum theory by the different authors to whom

the work has been assigned Some accept the theory whole-heartedly, others with evident hesitation

(1) Prof Kohlrausch of Graz has written a complete and impartial account of the science of radioactivity, and we have nothing but praise to give to this admirable volume In some Continental textbooks we have noticed a tendency to belittle or to ignore the work of the Cavendish Laboratory and the Cambridge physicists. No such tendency is to be found in this volume, where we meet repeatedly the names of J J Thomson, C. T. R. Wilson, E. Rutherford, and their numerous fellow-workers. The longest chapters in the book are devoted to gamma rays—a subject to which Prof. Kohlrausch has made important contributions—beta rays, and alpha rays Very remarkable are the results obtained by the use of Wilson's cloud chamber, by means of which the tracks of such rays are made visible In particular, mention may be made of the stereoscopic pictures by Meitner and Freitag (Figs 169 and 170), in which the path of a hydrogen particle set in motion by the impact of an alpha ray is clearly marked. Some of Blackett's photographs are also well reproduced We have taken special interest in the account of the H rays, including the description of Stetter's experiment, using Aston's mass-spectroscope to show that the mass of such a particle is identical with the mass of the hydrogen atom.

(2) The greater part of vol 18 is devoted to physical optics Rudolf Ladenburg gives an interesting critical account of the measurements of the velocity of light, taking Michelson's latest value, $c = 299,796$ km /sec., as a standard. In an added note it is pointed out that this is in close agreement with the value deduced by the astronomical method (H. Spencer Jones) [1]

M v. Laue is responsible for valuable articles on the optics of moving bodies, the reflection and refraction of light at the interface between isotropic bodies, and the interference and diffraction of electromagnetic waves (with the exception of X-rays) The first of these contains information as to recent researches not easily available to the student. The same remark applies to Bottlinger's short article on the relativistic displacement of spectral lines towards the red and the bending of light in the gravitational field of a star. The polarisation of light is well treated by Hans Schulz, who gives a careful account of historical and modern experiments and apparatus—we notice references are made to instruments by Hilger and by Bellingham and Stanley. Reproductions are given of the striking interference patterns of crystals due to H Hauswald.

A short article of 40 pages by E. Warburg on photochemistry is included in this volume. The author seems to have imposed severe restrictions on himself in his treatment of this subject, and the result is somewhat disappointing This arises in part from the complexity of the material, for although the quantum theory affords some explanation of the simpler photochemical processes, the reactions are in general complicated by secondary changes which cannot at present be traced in detail or subjected to critical analysis When absorption of incident radiation takes place, an electron is raised to a higher quantum level, or in other words, energy of radiation is transformed into quantum energy It is now assumed that, by interaction with another molecule, this quantum energy can be changed into another form of energy, in this case, chemical energy.

To set up and preserve the laws of statistical equilibrium a particular process can in general never be supposed to act alone, unaccompanied by a corresponding reverse process; only the two together form a possible single mechanism of interaction Collisions between electrons and atomic systems may be divided into two types, those in which kinetic energy of electrons is changed into quantum energy of atomic systems, and those in which the inverse change of quantum energy into kinetic energy of electrons occurs In thermodynamic equilibrium there must be just as many collisions of one type as of the other According to Franck, this conclusion must also be drawn with regard to the collisions between excited and unexcited atomic systems

(3) Vol 19 of the 'Handbuch', though less bulky than some of its companions, deserves special attention, as it has to do with subjects of great theoretical importance. Prof. Jaffé, of Giessen, writes on the related topics of the dispersion and absorption of light After a short historical introduction the classical theories are discussed briefly but adequately The theory of dispersion was first suggested by Maxwell in a question in the Cambridge Mathematical Tripos of 1869, but important work was done by Sellmeier (1871), who independently advanced the view that the differences in the velocity of light in different materials must be attributed to the direct action of the vibrating particles of the medium set in oscillation by the ether vibrations. The electromagnetic theory of dispersion is then described, and the

[1] See NATURE, vol. 120, p 602, 1927.

later developments consequent upon the adoption of the electron theory discussed Next we have an account of the application of the quantum theory to the problem, leading up to the dispersion formula of Kramers, and finally to the new quantum mechanics—a truly notable record of scientific progress The experimental aspects of the subject are next taken up, gases, liquids, and solids being considered in turn, and comparison between theory and experiment being kept in view throughout Chapter vi. deals with several related questions of great interest, such as the number of dispersion electrons, and the probability of quantum transitions.

Part II. consists of three chapters dealing with absorption, commencing with an account of the theories, including the collision theory of Lorentz and also the theory of Planck, in which the damping is referred solely to radiation. Then follow descriptions of experimental methods and of the results obtained for gases and vapours, liquids and solids. The whole work is well done and deserves high praise.

Prof. Gans of Konigsberg contributes a short chapter on media with variable refractive indices, and a further three chapters, which, in view of the growing importance of their subject, might well have been longer, on the molecular scattering of light.

(4) The difficulty of dealing with the vast amount of material accumulating as the result of modern scientific research is illustrated by the volumes on phosphorescence and fluorescence The method, which consists in abstracting or reproducing in considerable detail a large number of original papers, is far from attractive In the opinion of the reviewer, who sympathises with the authors in their task, more severe pruning and more critical selection would have increased greatly the value of the resulting work We hold that the author of such a volume need not attempt to provide an exhaustive account of all available data, even were that humanly possible, but rather to supply a judicious and stimulating survey of the main facts and theories In the subject of luminescence the difficulty is acute, arising in part from the fact that the development of the theory has not kept pace with the increase in the number of facts of observation and experiment.

The historical method is followed in the earlier part of the volume, which begins with an account of the observations of Canton, Stokes, and Becquerel, followed by a description of the work of Klatt (to whom the book is dedicated), of Lenard and his fellow-workers, notably Hausser and Saeland. We can do no more than mention the investigations of Gudden and Pohl on the electrical conductivity of phosphorescent materials when illuminated, and the work of the same investigators and of Schmidt on the dielectric constant of the material

(5) The second part of Vol 23 contains five chapters which conclude the discussion of phosphorescence and fluorescence, and five more covering some 500 pages which are concerned with photoelectric activity In the chapter on fluorescence, it is pointed out that the time during which the emission continues after the cessation of the stimulus does not afford a sharp criterion to enable us to distinguish between fluorescence and phosphorescence It is suggested that a better criterion may perhaps be found in the photoelectric effect, which postulates the complete separation of electrons from the active centres of the phosphore in all cases of phosphorescence of long duration.

Of outstanding interest are the researches of R. W. Wood and others on the fluorescence of gases and vapours. When sodium vapour is illuminated by sodium light, some of this light is re-emitted without change of wave-length as *resonance radiation* But, in addition, other monochromatic radiations, forming *resonance spectra*, are given out when the vapour is illuminated by the light of metallic arcs. Recent investigations have done much to unravel the complicated line spectrum obtained in this way

The section on photoelectricity is mainly due to A Becker, and even if emphasis is laid on the work carried out by German investigators, it is useful to have the results summarised by one who has himself made important contributions to the subject We may mention in particular his work on the relation between photoelectric and thermionic emission. The reviewer turned at once to the chapter on photoelectric fatigue, and was interested to find that this perplexing phenomenon is attributed by the author mainly to the influence of gas (ozone) or vapour (water vapour) on the emission of electrons The final chapter is on the practical applications of photoelectricity, and refers to the increasing importance of photoelectric cells in photometry.

It was by studying the energy of photoelectric emission that Einstein in 1905 was led to the theory of light quanta, which seemed in direct antagonism to the wave theory of light. The energy of the light quantum of frequency ν was assumed to be $h\nu$ where h is Planck's constant.

We may conclude with a question put by Schrodinger at the end of his lectures on wave mechanics: Is it quite certain that the conception of energy, indispensable as it is in macroscopic phenomena, has *any* other meaning in micro-mechanical phenomena than the number of vibrations in h seconds?

H. S. Allen

The Evolution of Human Races.

L'Ologenèse humaine (Ologénisme) Par Dr. George Montandon. Pp. xi + 477 + 14 planches. (Paris: Félix Alcan, 1928.) 200 francs.

Dr. George Montandon is known to anthropologists because of the contributions he has made to our knowledge of the Mongoloid peoples of Asia, of the inhabitants of Abyssinia, and of the primitive cultures of Africa. In the present imposing book he appears as the author of a work on systematic anthropology. He has here attempted to do two quite separate things: to give a systematic account of the living races of mankind—of which he distinguishes twenty—and at the same time to apply a new theory to explain the origin of human races. The theory of evolution which he applies is that formulated by Prof. Rosa of Modêna in 1918 and named by its originator 'ologenesi' (holos, entire). We think the author would have done much better to have written two books—one for the exposition of the theory he has adopted, and utilised the other for his valuable data and charts relating to the descriptive ethnology of mankind. In brief, the theory is the weakest part of Dr. Montandon's book, and many anthropologists may turn away before they reach the really valuable chapters. We also think that the earlier chapters, which attempt to trace the origin of the earth and of life, might well have been omitted.

After citing the various theories which have been formulated to explain the origin of new species—Lamarckism, Darwinism, neo-Lamarckism, neo-Darwinism, mutationism, etc.—the author rejects them all in favour of Rosa's 'ologénisme', and proceeds to apply this theory to explain the facts of human evolution. It is not necessary to enumerate all the postulates of his theory; they are numerous and arbitrary. We need only mention two or three which are essential to understand its application to a race of human beings. The theory presumes that every man, woman, and child of a race is 'wound-up', so that all, after passing through a certain number of generations, will arrive at a critical or maturation stage. On this stage being reached the whole species divides, half of the individuals being changed into one kind of race, the other moiety into another. Races 'unwind' and reach critical stages at different rates—some rapidly, others slowly—so that a backward race may be a true cousin of another which is highly advanced. The theory is determinist in nature, but environment, habit, and competition are operative and modify the result. Races have also arisen by hybridisation. Further, as mankind is and has been distributed over wide areas of the world for long geological epochs, each area being the scene of independent advance, it is foolish to speak of, or search for, a limited area of origin or cradle for mankind. Under this theory a new race appears at the same time over a wide area.

In a brief notice such as this, it is impossible to give a full exposition of Dr. Montandon's ideas, but enough has been stated to place the reader in possession of their trend. Their practical application, even in Dr. Montandon's hands, requires a considerable degree of constraint to make facts fit with expectation. On the other hand, the author never shirks facts; he has searched all the latest literature dealing with blood reactions, immunity, etc., and sought to fit them into his scheme. Indeed, the book is a valuable repository of fact, even if the theory of 'ologénisme' proves to have little or no permanent value.

Chemistry and Physics of Sea Water.

Biological Chemistry and Physics of Sea Water. By H. W. Harvey. (Cambridge Comparative Physiology Series.) Pp. x + 194. (Cambridge: At the University Press, 1928.) 10*s.* 6*d.* net.

This book deals with the particular chemical and physical conditions in the sea which appear to be most important in affecting the growth of plants and animals. The author reviews the results of researches subsequent to the publication of Krummel's "Handbuch der Oceanographie" in 1911. Since H.M.S. *Challenger* led the way in 1872, there has been a steady increase in the number of vessels investigating the high seas, while at the same time marine biological stations established in increasing numbers in different countries have investigated the conditions in coastal waters. The combination of a laboratory on shore with a small sea-going vessel has proved particularly fruitful, and provides the author with much of the material for this book.

Chapter i. gives a brief summary of the general physiology of marine organisms, the factors controlling photosynthesis, and the relation of the

animals to changes in oxygen tension, temperature, and light. The part played by the so-called dissolved organic matter is still obscure, but it is probably important Chapter ii. deals with the chemical composition of the water, the dissolved salts and gases, and the hydrogen ion concentration Practical details for the estimation of the more important substances are given There is an interesting table of the elements occurring only in minute traces in the sea, of which there is a large number. Many of these rare substances are extracted from the water by the organisms, and they may assist or even replace related substances in metabolic processes, as copper replaces iron in the respiratory pigments of the Crustacea.

Recent work on the supply of food materials for the phytoplankton has shown that the nitrates and phosphates are formed in the deeper layers and are brought to the surface by currents This dependence of the phytoplankton (and of course ultimately all the plankton, great and small) on currents leads to considerable space being devoted to water movements. The understanding of these movements is facilitated by a number of clear diagrams. A short account is given of the recent work of Bjerknes and Sandstrom on the mathematical treatment of currents Chapter iv. deals with the gain and loss of heat by the water and with the currents, which are largely responsible for the vagaries of temperature that are found in many places. The study of the distribution of temperature with depth shows that in summer a layer of warmer water from 10 to 50 metres in depth overlies a layer of colder water, there being a difference of temperature of several degrees between the two. This condition, which occurs regularly in the summer in lakes in temperate regions, has only recently been noticed in the sea, although many of the old temperature records show it quite clearly. The difference in density between the two layers prevents them mixing freely, and so prevents the phosphates and nitrates formed in the deeper water from reaching the surface where they can be utilised by the plants A prolonged period of fine weather in summer may therefore cut off the food supply of the phytoplankton

Chapter v deals with the colour and the penetration of light into sea water. There is here a considerable field for experimental work, apart from that on photosynthesis, on the effects on marine organisms of light of different wave-lengths. Chapter vi. concludes with a brief review of factors influencing the fertility of the sea and its fluctuations. Here we are no nearer the solution than we are to solving the problem of the fertility of the soil, and one of the greatest difficulties in the way is that we know so little of bacterial activity

The author has succeeded in presenting the reader with a clear review of the present position of the study of the physical environment in which marine organisms live There is a list of references to recent literature at the end of each chapter, which adds to the value of the book. It can be recommended to all who are interested in the sea, and particularly to those who are studying the physiology of its inhabitants

Our Bookshelf.

Lehrbuch der Experimentalzoologie · Experimentelle Entwicklungslehre der Tiere Von Prof Dr. Bernhard Durken. Zweite Auflage. Teil 1. Pp 320 Teil 2 (Schluss) Pp xii + 321-782 (Berlin: Gebruder Borntraeger, 1928.) 51 gold marks

In his first few pages the author of this book defines very accurately the scope of the subject with which he deals It is to include all branches of the analytical study of development in the animal organism considered as a whole, but not that of its parts considered separately In the book he therefore discusses heredity, fertilisation, and the differentiation of specific form He does not deal with the growth of the body in size. Having so defined his subject, he proceeds to name it " Experimental Zoology". The use of this title is open to objection from many points of view. In the first place, it is not descriptive. The experimental method is now used, or is coming to be used, in all branches of the science, wherever its use is effective Its use is certainly as characteristic of many other branches as it is of the subject of this book. But a more important objection is that a classification of a science by the methods used in its various branches must always be unsound. In zoology this type of classification has been widely used and owes its origin to the history of the science. To speak of experimental zoology to-day in the sense of the author of this book, or in any similar sense, is an anachronism It would surely be better to allow the term to fall into disuse and to name all the subdivisions of the science according to the subject matter of each. It would not be difficult to choose such a title for the subject of this book

Probably the chapters which deal with the experimental study of differentiation will be of most use to biologists outside Germany This is a subject which German biologists have made particularly their own, and a good summary of their recent work upon it was needed This need the book seems to supply. The other parts of the subject have been more frequently summarised, and the account given here is often short and sometimes incomplete. In particular, only some of the aspects of fertilisation are discussed, and a theory is put forward in regard to it with which by no means all workers upon the subject will agree.

It is perhaps not surprising that the examples

quoted are largely results obtained by German workers. Numerous examples could be given in which work of apparently equal or greater importance by other biologists is not discussed. In other respects the second edition of the book appears to have been brought up-to-date. It should be useful to biologists in Great Britain.

A Laboratory Manual of Elementary Physical Chemistry. By Prof. Edward Mack, Jr, and Prof. Wesley G. France Pp xi + 195. (New York D Van Nostrand Co , London Macmillan and Co , Ltd., 1928) 8*s* 6*d* net.

The laboratory manual of Profs. Mack and France begins with three theoretical " Exercises ", dealing with units and dimensions, significant figures, and errors of experiment, respectively These are followed by a series of thirty-five experiments, of which two are concerned with determinations of molecular weights in solution, two more with conductivities and transport numbers, two with the preparation of a standard cell and the study of a concentration cell, whilst the hydrogen electrode and indicators form the subject of two more experiments in the electrical section of the book. These experiments provide adequate samples of measurements of those properties of dilute solutions of electrolytes which have occupied such a prominent position in physico-chemical literature during the past forty years, but they leave room for an exceptionally large proportion of experiments with gases and liquids other than dilute solutions

The course is therefore exceptionally well-balanced, and can be recommended on account of its progressive outlook The text dealing with the individual experiments is well written, and is presented in an attractive form. The manual is a competent and trustworthy guide for a laboratory course of thirty-six periods, and would serve as a good preparation for more advanced work in physical chemistry.

The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland · a Record of Work done in Science, Literature, and Art during the Session 1927–1928 by numerous Societies and Government Institutions Compiled from Official Sources. Forty-fifth Annual Issue Pp. vii + 420 (London: Charles Griffin and Co , Ltd , 1929) 18*s* net.

A note of warning is sounded in the preface to the new issue of this valuable annual. The publishers state that for some years past " the heavy cost of production has been altogether out of proportion to the sales ", and that although they are anxious to continue their part, they cannot do so without more support.

As usual, the societies included are grouped in fourteen sections according to the subject of their activities. Societies with London headquarters come first, followed by provincial, Scottish, and Irish societies. In each case the address, officers, and particulars of meetings, membership, and publications are given, followed by a list of papers read during the session 1927–28. Incidentally, it is remarked that in future, only papers which are published are to be included, so that the Year-Book will be an index of published work, and as such alone the volume must be of considerable service Government departments such as the National Physical Laboratory are included in their appropriate sections.

The thanks of scientific workers generally are due to the officials of the societies who have co-operated with the publishers in making the Year-Book not only available but also authoritative. We hope with the publishers that sufficient sales will be forthcoming to make possible the continuance of this useful reference book.

Preparation of Scientific and Technical Papers. By Prof Sam F Trelease and Emma Sarepta Yule Pp 117. (London Baillière, Tindall and Cox, 1927) 7*s* net.

If every beginner, and some experienced transgressors, were to digest the contents of this little book before again attempting to place on printed record the method and results of a scientific investigation, critics of the quality of such contributions to literature would in large measure be deprived of illustrative material, of which there is at present no lack Indeed, had the advice which the authors offer been less well founded, and their specific directions less generally acceptable than is in fact the case, they would still have rendered notable service in emphasising the importance in such matters of clear and logical presentation, of attention to detail, and of a reasonable measure of uniformity Thus, whilst there may be two opinions concerning some of the individual instructions, there can be one only concerning the value of the book as a whole. The subject matter deals concisely with the arrangement of a paper and its preparation for the press, and the attention which is afterwards required of the author ; it includes a description of methods of citation, abbreviation, tabulation, and illustration. Editors and readers of scientific literature will agree that there was room—on many a shelf—for such a book. A A. E.

A Classbook of Practical Chemistry. First Year. By J. Morris Pp viii + 103. (London Methuen and Co., Ltd., 1928) 2*s*.

This book is intended for pupils commencing the study of chemistry. A new feature is that the directions for carrying out experiments are given on the left-hand pages, while the results are described on the right-hand pages, and the author suggests that " by the adoption of some simple method of covering, the right-hand page is completely hidden during practical work ". The success of such a scheme must depend largely upon the teacher and upon the age of the pupils. The instructions for carrying out experiments are simple and clear, but the scope of the book might with advantage have been slightly extended to include such experiments as the preparation of hydrogen and nitrous oxide. The melting and boiling points of sulphur are given as 115° C and 448° C. instead of 112·8° C. and 444° C. respectively. The equation for the reaction of magnesium with carbon dioxide (p 39) is incorrect.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Ozone Absorption during Long Arctic Night.

IN NATURE of April 27, p. 644, Prof R. W Wood again raises the hopes of astronomers that it may be possible to obtain an extension of the ultra-violet spectra of the sun or stars by going to a station near the pole at the end of the winter. He assumes—as most people have done—that the ozone in the atmosphere is formed by ultra-violet radiation from the sun, and since it is the absorption by ozone which causes the abrupt extinction of stellar spectra at about 3000 A., he naturally concludes that this absorption would be least where the upper atmosphere has had least sunlight

I fear that it is necessary to dash any such hopes of astronomers, and possibly this note may save someone from the discomforts involved in a fruitless expedition to high latitudes in the winter. We have now, by the kindness of a number of helpers, a series of observations extending over many months at twelve stations, ranging in latitude from 70° N. to 45° S. These observations are quite regular and consistent, and show that the lowest ozone values are found in tropical regions at any time of the year, while the highest ozone values are found in high latitudes in spring In the tropics there is practically no annual variation, but in high latitudes the annual variation is very large (the maximum amount of ozone is about twice the minimum amount), the maximum being in spring and the minimum being in autumn. The autumn values in high latitudes are nearly as low as those in the tropics, so that while in the spring hemisphere the amount of ozone increases rapidly from the tropics to the pole, in the autumn hemisphere the amount of ozone is nearly constant at all latitudes.

These results are, of course, quite inconsistent with the suggestion that the ozone is formed by ultra-violet radiation from the sun. The shortest wave-lengths from the sun will undoubtedly form ozone, but the longer waves which are strongly absorbed by ozone will decompose it As there is so much more energy in the band of longer wave-length, it is not surprising that the equilibrium amount of ozone, when the atmosphere is subjected to both wave-lengths, should be very small. What forms the ozone is not, at present, certain, but the connexion found between the amount of ozone and magnetic disturbance might suggest some action associated with the aurora, though occurring lower down (the ozone appears to be at a height of about 40 to 50 km , while the minimum height of the visible aurora is about 90 km.) Whatever the action forming ozone, it is clear that the equilibrium amount due to sunlight is always smaller than the amount actually present, so that the sunlight tends to reduce this amount

If astronomers wish to get spectra extending as far as possible into the ultra-violet, they should go to the tropics, or should choose days in temperate regions during the autumn with anticyclonic conditions and a tropical air current above, as under these conditions the amount of ozone is as low in temperate regions as in the tropics.

G. M. B. DOBSON.
Boars' Hill, Oxford, April 27.

Thyroid and Temperature in Cold-blooded Vertebrates.

THE thyroid is well known to be concerned with temperature regulation in homothermic animals It seems, however, also to have a somewhat analogous function in cold-blooded forms In an experiment undertaken to investigate the temperature coefficient of metamorphosis, a number of sets of half-grown *Rana temporaria* tadpoles, after all being exposed to the same concentration of filtered thyroid suspension in water for the same length of time, were placed at various temperatures from 3° to 30° C. The thyroid dosage was moderate, sufficient to produce metamorphosis in about a week at room temperature

As expected, temperature exerted a marked effect on metamorphic rate Those exposed to temperatures below 5° C , however, provided a surprise After showing a certain degree of change, they proceeded no further in metamorphosis Even when removed to room temperature, they continued indefinitely in this half-and-half condition, as shown in the photograph (Fig. 1), taken several weeks after removal.

That permanent intermediate conditions between larva and adult could be obtained in urodeles was already known from the work of Jensen and others on axolotls This is, I believe, the first case in Anura It confirms the view that metamorphosis is not an all-or-nothing reaction The relation to temperature, however, is what especially concerns us here The half-and-half state can only be interpreted as follows . (1) the treatment with thyroid *ab extra* causes a marked compensatory reduction in the animal's own thyroid (a fact well known in amphibian experiments) , (2) some of the effect of the thyroid dose, which causes rapid metamorphosis at higher temperatures, is here used up in counteracting the effect of low temperature instead of in producing metamorphosis.

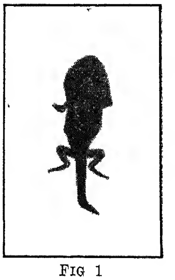

FIG 1

Something of the same sort can be deduced from other work, such as that of Adler, who found that in untreated tadpoles high temperature caused regression of the thyroid, low temperature hypertrophy, both in growth and functional activity.

The conclusion appears to be justified that in tadpoles the thyroid is acting as a primitive temperature-regulator, or rather as a *temperature-buffer* The metabolism of tadpoles is lower in the cold than in the hot , but thanks to the thyroid's hypertrophy in the cold and regression in the hot, and to the fact that thyroid secretion increases metabolism, the difference is not so great as it would be without a thyroid On this view, the temperature coefficient of oxygen consumption and other metabolic activities should be greater in thyroidless than in normal tadpoles It would be of great interest for anyone who has command of the technique of thyroidectomy in frog embryos to put this deduction to the test

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Mimicry.

IN NATURE of April 27 there appears an article on mimicry by Dr. Hale Carpenter, of Uganda, in which he pays me the compliment of quoting extensively from an essay of mine on evolution which appeared in the volume " Evolution in the Light of Modern Knowledge ". In Dr. Carpenter's article he asserts

that 'natural selection' affords the only satisfactory explanation of mimicry, and he criticises the tentative explanation which I put forward

I quite freely admit that I am unable to give an explanation of the numerous facts adduced by Dr Carpenter To do so would require years of original work in each locality, the environment, both physical and biological, would have to be thoroughly analysed in each case, which notoriously has not been done We should have to account for the fact that in some cases the supposed model is rare and the mimic far more numerous, and we should have to deal with the distressing circumstance that evidence for serious attack by birds on butterflies in the adult condition is sadly lacking Bergh in his "Nomogenesis" states that only one example of this was known to him, and that was in Ceylon, where the bee-eaters (Meropidæ) devour large numbers of the supposedly distasteful Danaidæ !

Of one thing, however, I am certain, and that is that 'natural selection' affords no explanation of mimicry or of any other form of evolution. It means nothing more than 'the survivors survive' Why do certain individuals survive? Because they are the fittest How do we know that they are the fittest? Because they survive. Is not this a mere form of words, just as deserving of condemnation as the phrase 'the Will of God' used by Darwin's theological opponents?

That more young are born than can survive was known to Lamarck, and is explicitly set forth in his "Zoological Philosophy", but he did not make the mistake of supposing that the killing of James can affect the qualities of Tom. Put in other words, natural selection can only 'select' what is already there, and the real problem for science is how 'what is there' came into existence Towards the solution of this problem, so far as it affects the wing colours of butterflies, very little has as yet been done, nevertheless, a beginning has been made Sir Frederick Gowland Hopkins has shown that uric acid forms the white background in the wings of Pieridæ, and my friend, Dr. D. L Thomson, now lecturer on bio-chemistry in McGill University, Montreal, has shown that in another family the colour of the background is due to a substance in the plant on which the larva feeds. Only along such lines as these will the problem of animal coloration be solved.

When the school to which Dr Carpenter apparently belongs are asked how the variations which are 'selected' originate, their only answer is 'chance', and 'chance' as an explanation of a regularly recurring biological phenomenon does not commend itself to me E W. MacBride

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Dr Hale Carpenter in his article on mimicry (Nature, April 27) mentions that it is held by many as an objection to the theory of the evolution of mimetic forms by natural selection that the mimic must be mistaken by the predatory animal for its model, if the resemblance is to be of any use to it, and that therefore slight resemblances will be useless, and the evolution of the perfected resemblance unintelligible. This difficulty, he suggests, may be removed by the consideration that the mimic need only *remind* the enemy of its model to set up a repulsion in its mind and so escape. He instances our repulsion to a worm, which he attributes to its resemblance in form to a snake, for which we have an ancestral repulsion

Is this necessary? Does not the objection in any case rest upon far too anthropomorphic a conception of the animal mind? Psychologists tell us that the animal may be regarded for practical purposes as unreasoning in everyday life If this is so, the mental processes of an animal such as a bird in searching for its prey will be very different from ours in looking for an object. We, as we examine the bark of a tree for an insect, are continually comparing the form of each piece of bark with that of the insect, and considering whether it is bark or insect. The bird will not consider, its glance will pass over the bark, often slowly and with *apparent* care, until some object, by its resemblance to the remembered picture of the insect, starts the feeding reaction There is no conscious comparison, the stimulus is received and the reaction follows instinctively. To protect the insect, its resemblance to the bark need only be sufficient to keep the stimulus, when the bird's glance lights upon it, below the threshold value for the reaction

Protective resemblance and mimicry are here entirely parallel The probability of stirring up the feeding reaction will be less the more perfect is the resemblance either to an inedible animal or to an inanimate object, but it seems that a very slight resemblance may often be effective We know how readily we may mistake objects at a first glance, especially when our minds are inactive, for others to which they have only a slight resemblance A man, waking from sleep, may mistake clothes thrown over a chair for a person in his bedroom A second glance, always accompanied by thought and comparison, shows him his mistake, but for the animal there is no such thought and comparison. Hudson ("Birds and Man", Dent, 1923, pp. 46-8) has an account of an incident in which he was mobbed at dusk by a flock of goldcrests, and later by another of swallows and house-martins in full daylight. The behaviour of birds was due, as he afterwards showed, to the resemblance of the colour of his cap to that of the fur of a cat. The acuteness of the vision of the predatory animal only enters indirectly into the problem. The bird's vision may be easily acute enough to distinguish the differences between the mimic and its model, just as the swallows could certainly have appreciated the difference in form between the cap and the cat. Yet the differences may be unperceived and the resemblance effective, even when it is slight These considerations seem to remove the difficulty, felt by many, in the evolution of mimicry and protective resemblance from beginnings which must have been very imperfect G S Carter.

Zoological Department
University of Glasgow

Anomalous After-Effect with Quartz

The true and the apparent resistivities of some dielectrics have been found by S W. Richardson (*Proc. Roy. Soc*, A, **92**; 1916, **107**; 1925), one of the writers (the paper is now in the press at the Tôhoku Imperial University), and others The apparent resistivity of quartz under a certain constant applied potential increases rapidly with time and then gradually tends to a saturation value after about 30 minutes for quartz plate cut perpendicular to its optical axis. (The resistivity is measured by conducting charge through dielectrics under various applied potentials, and the time means the duration of the application of a constant potential.)

It may be expected from the paper of one of the writers (*Sci Rep. Tôhoku Imper. Univer.*, **10**, 101, 1921) that the apparent resistivity will show some anomaly for applied potential which increases beyond the 'limit potential'. Thus, we found an anomalous after-

effect on the apparent resistivity of quartz plate cut perpendicular to its optical axis. First, we put a known potential on the quartz during a constant time interval (always 10 minutes), in this time interval the quartz is made to conduct the electric charge freely, and it is connected to earth during a known time interval; then putting on a known potential, the accumulated charge due to conduction is measured during a known time interval, in this case the ap-

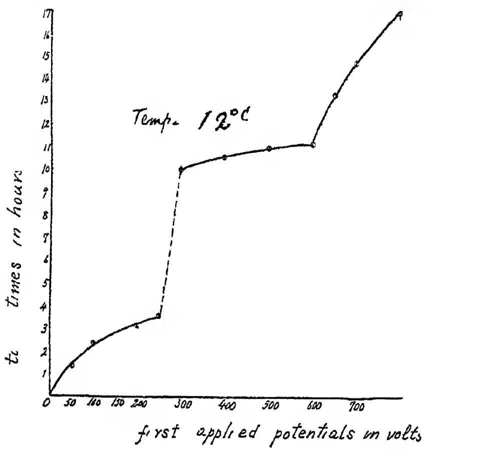

FIG 1.

parent resistivity is much smaller than that of the quartz in neutral state Next, it is earthed until the residual charge and the time effect due to the latter potential have completely disappeared, and then the measurement of the apparent resistivity is made under the same external conditions as the above during a known time interval, and then it is earthed, in this case the apparent resistivity is a little larger than that of the first, but yet smaller than that of neutral state.

The measurement and earthing as above are

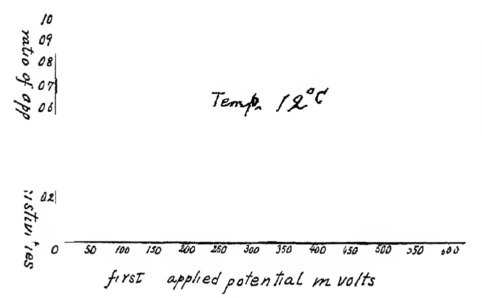

FIG 2

repeated until the effect of the first applied potential disappears. The variation of this total time interval for the first applied potential which affects the apparent resistivity as an after-effect is given in Fig 1. The potential for measuring the apparent resistivity is always 50 volts. The temperature of the quartz is always kept at 12° C. As shown in Fig 1, the time interval during which the after-effect exists increases slightly with the potential and is discontinuously increased at the potential between 300-350 volts per mm thickness (250-300 volts for actual thickness), and again slowly increases, and from about 700 volts per mm. thickness (600 volts for actual thickness) it increases rapidly, and it seems that it gradually tends to a saturated state. In the paper of one of the writers above referred to, the limit potential is most important for dielectrics, and for quartz is equal to 324 volts per mm. thickness as the mean value from the residual charge and time effect Thus it can be concluded that the anomalous after-effect appears at the limit potential.

Fig 2 shows the variation of the ratio of the apparent resistivities at 5 minutes after the first earthing and the neutral state, with respect to the first applied potentials, the rate of decrease of the apparent resistivity increases rapidly in the neighbourhood of the limit potential and then gradually tends to a saturation value.

The decrease of the apparent resistivity and the appearance of the anomaly are exactly the same in both cases, the first applied potentials are positive and negative, and the after-effect depends simply on the absolute value of the first applied potentials. Hence it seems to us that this anomalous after-effect is probably due to some property of the atomic lattice of quartz.

H. SAEGUSA.
S. SHIMIZU

Institute of Physics,
Tôhoku Imperial University, Sendai,
Mar. 2.

Plasticity and Water Absorption of Clays.

IN spite of the cause of the plasticity of clays having been the subject of much speculation, no generally accepted theory appears to have been developed. The following measurements of water absorption and some other properties of clays throw further light on the problem and appear to me to be of general interest in the theory of the properties of colloids.

The 'water absorbed' was measured by determining the increase in concentration in chloride ions which occurred when the clay, dried at 100°, was added to a standard solution of the chloride of the base with

TABLE I.

CLAY FROM HEAVY COTTON SOIL No. 38724.

Base in Clay	Water absorbed from Chloride Solutions per 100 gm of Clay		Plasticity Number	Relative Hardness	Bulk Density
	N	$N/10$			
Li	18 4	46 5	82	92	2 12
Na	12 8	34 4	60	85	2 07
Mg	10 4	17 4	56	82	2 01
Ca	8 3	16 8	42	57	1 80
NH_4	5 2	15 4	22	6	1 70
K	2 7	15 1	22	1	1 45
H		5 3	20	0	1 65

which the clay was saturated, it having been proved by various workers that clay does not absorb the chlorine ion Five grams of clay were usually added to 10 c c. of solution, after centrifuging, the weighed decanted liquid was titrated with silver nitrate solution. This method of 'negative absorption' seems to have been strangely neglected in the study of the water affinity of colloids in spite of its use by McBain in the study of soaps, and by Gaunt and Francis for silica, and ferric, and aluminium hydroxide gels (*Trans. Faraday Society*, 24, 32, 1928) The other three properties tabulated were determined on the soil which contained 60 per cent of clay. The relative 'hardness' figures represent the percentage material which failed to be powdered after a standard shaking treatment of dried pellets of each material. The Atterberg

plasticity number represents the range of percentage water content over which the soil remains plastic.

This direct demonstration of the lyophilic series correlates nearly perfectly with the other properties tabulated Preliminary counts in an ultra-microscope of the number of particles per gram of clay seem to indicate that the ultimate dispersion of these clays will also follow the order of hydration, but it should be emphasised that this is not the same as the order of the flocculating concentrations of the different clays by the chlorides of the respective bases.

These figures show clearly how the properties of one clay with different bases follow the water absorption of the clay, Table II shows in a preliminary way how the plasticity of different clays with the same base (sodium) also follows the water absorption The properties of some of these clays have been described by Joseph and Oakley (*Jour. Agr. Science*, **19**, 121, 1929)

Table II

Clay from—	SiO_2/Al_2O_3	Water absorbed from N/10 NaCl by 100 gm Clay	Plasticity Number of Soil	Clay (per cent in Soil)
Bentonite	7	41 8	441	91
38724	4 0	31 3	60	62
30100/1	3 7	28 5	56	74
29933/4	2 7	26 6	37	57
13107	2 4	18 5	20	80
Amorphous silica .		15 1	about 1	
Kaolin 10096	2 0	3 0	about 1	about 64

Although the clay contents of the soils are not comparable, the influence of the composition and hydration of the clays is still sufficient to determine the plasticity. This is particularly striking in the low plasticity of No. 13107. This soil contains 80 per cent of a clay which, as shown by the ultra-microscope, contains more than twice as many particles as No. 38724 It is evident that although the fineness of a clay may be a factor in its plasticity, the water affinity is more important.

Finally, the water absorbed by a clay is greatly influenced by the concentration of the reference salt used in the solution. This is presumably an osmotic effect Below is shown the effect of different concentrations of sodium chloride on the water absorbed by sodium 'saturated' clay No 38724.

Dilution of NaCl (litres) .	0 2	1	10	25	50	125
Water absorbed per 100 gm dry clay	6 7	12 8	34 4	49 0	80 0	102

In keeping with this change in absorbed water the plasticity number fell 13 units when normal sodium chloride solution was used instead of pure water Experiments at higher dilutions are rendered difficult by the deflocculation of the clay. At present it is impossible to decide whether this phenomenon of water absorption is due to imbibition by hypothetical gels in the clay or to a kind of polar absorption round each clay particle as postulated by Hatschek for other colloids (*Jour Phys. Chem.*, **31**, 383, 1927) and others (Weisner and Cunningham, *Jour. Phys Chem*, **33**, 312; 1929). In view of the increase of dispersion with hydration observed in the ultra-microscope and the impossibility of separating a clay into two fractions of markedly different properties, I incline to the latter view.

H B. Oakley.

Wellcome Tropical Research Laboratories,
Khartoum, April 7.

Co-education.

In Nature of April 13, I note an article which seems to me to maintain the thesis that co-education in the medical schools of London is undesirable because its prevalence would interfere with the efficiency and success of the London School of Medicine for Women. I would suggest that your brief against co-education is carried considerably farther than the highest authorities at the London School of Medicine for Women really desire, if one may judge from a letter to the *Nation and Athenæum*, written by Sir Francis Acland, the chairman of that School, dated April 9. In that letter Sir Francis expresses a pained surprise at my suggestion that the London School of Medicine for Women objects to co-education He declares: "All the evidence given by the School before the Committee" (that is, the recent University Committee) "was in favour of co-educational facilities, and we have always welcomed every extension of it." The 'quota' system, which is condemned in Nature, was first suggested by the Professorial Board of University College in 1915, since which date University College Hospital has taken a quota of twelve female students annually, and the system has worked with complete success

You ask why the recent University Committee, appointed on the motion of Mr Walter Spencer and myself, should have declared that there was a "prepossession in favour of co-education in the University". The reason is probably to be found in the report of a previous University committee in 1915, which had investigated this very question of medical co-education at the men's schools of London. That report was overwhelmingly in favour of co-education as a principle. It is significant that the large majority of women's societies have taken the view that co-education should be practised in the medical schools of the University of London as it is practised in provincial universities.

E. Graham Little

House of Commons, S.W 1, April 18.

Dr. Graham Little is well known as a champion of medical co-education, and we print his letter on the subject with pleasure. The article in Nature was not intended to indicate any general objection to co-education, but we suggested that the question of medical co-education in London constitutes a special problem since a well-organised system of unisexual medical schools is already in existence. Conditions in 1915 during the War were quite exceptional, and the view then taken on the question of medical co-education cannot be regarded as binding the University We retain our dislike of the 'quota' system, notwithstanding Dr. Graham Little's interesting evidence as to its origin and working

The Editor.

Active Nitrogen.

The recent analysis of the band spectrum of nitrogen in the Schumann region by Profs R T. Birge and J. J Hopfield (*Astro. Jour.*, **68**, p. 274; 1928) throws a flood of light on the identity of active nitrogen. It has been shown that the bands in the Schumann region have nothing in common with the bands in the visible and the ultra-violet. The presence of a strong metastable level in the N_2-molecule has thus been established, and is in accord with the electronic level scheme of R. S. Mulliken (*Phys Rev.*, **32**, p. 216, 1928).

That active nitrogen is a molecule of nitrogen in this metastable condition is further supported by some recent experiments which we have carried out on the life of active nitrogen. This can be varied within wide and indefinite limits simply by the regulation of pressure, everything else remaining constant. For a short life of the order of 0·1 sec. the experiment is best performed by drawing our nitrogen at about 7 to 8 mm. pressure from a region of condensed discharge For very low pressures, say 0 03 mm of mercury, the active nitrogen is formed with an electrodeless discharge, and its life may be abnormally extended to several minutes It has been clearly observed by us that for any given specimen of nitrogen the life of active nitrogen increases continuously and regularly with the decrease of pressure This is a strong evidence for the presence of metastable molecules.

In another series of experiments we have produced the infra-red lines of nitrogen belonging to the electronic configurations $2L_2M_1 \longleftarrow 2L_2M_2$ by exciting first nitrogen and then active nitrogen with uncondensed discharge under exactly identical conditions No change in the relative intensity of lines was observed, which points to the conclusion that there is no appreciable density of atoms present in active nitrogen.

P K. KICHLU.
S. BASU

Department of Physics,
Science College, Patna, Mar. 27.

DR KICHLU and Mr Basu seem to have overlooked an early investigation (*Proc Roy. Soc.*, A, vol. 86, p. 264), in which it is shown that a given sample of active nitrogen, made active at a low density by the electrodeless discharge, can, after intervals up to several minutes, be made momentarily very bright by compression

This experiment seems to cover what Dr Kichlu and Mr. Basu have observed, with the additional point that compression causes the active gas to give up its energy rapidly *in the form of light* (α bands)

This seems clearly to prove that collisions of some kind are the occasion of the emission of α bands (1st positive nitrogen bands)

I am not sure if I understand the views of the authors rightly But the level which Mulliken concludes is metastable is the lower level concerned in the emission of the α bands. It is not clear to me how the metastability of this level helps us to understand how the gas remains for a long time loaded with the energy necessary for the emission of α bands, which involve a level several volts higher

RAYLEIGH.

Terling Place,
Chelmsford, Essex, April 24

Properties of the Terms of the Helium Molecule.

IF in a diatomic molecule the influence of the internuclear axis on the valence electron is strong compared with the influence of the nuclear rotation (case I.), the component σ, along that axis of the vector l representing the moment of momentum of the electron, is, as was shown by Hund, a whole multiple of $h/2\pi$, and the rotational energy is, apart from a constant, proportional to $j(j+1)$ (j = total moment of momentum of the molecule) If, on the other hand, the influence of the rotation is predominant (case II.), l is quantised with respect to the axis of rotation, and if its component along this axis is ρ, the rotational energy is proportional to $(j-\rho)(j-\rho+1)$ The energy in the intermediate case is a complicated function of j, and has been calculated approximately for simple cases by Hill and van Vleck (*Phys. Rev*, **32**, p. 250, 1928).

Case I is realised in most molecules The electronic spin usually complicates the problem In the helium band spectrum we can observe, as already shown in a qualitative way by Weizel (*Zeit f. Phys.*, **52**, p 175, 1928), all the different stages of transition between the cases I and II The terms which are produced by the different orientations of orbits with $l=2$ (δ-complex) are of special interest The bands which originate from a combination of this complex with the $2p$-level show a very anomalous behaviour both with respect to the position of the lines and to their intensities All their properties can, however, be understood, if one follows the transition from case I. to case II The connexion between the theoretical and empirical term symbols and the values of σ and ρ is given below.

Term Case I	$\pi\Sigma_b$	$\pi\Pi_a$	$\pi\Pi_b$	$\delta\Sigma_a$	$\delta\Pi_b$	$\delta\Pi_a$	$\delta\Delta_b$	$\delta\Delta_a$
Term Case II	π_1	π_0	π_{-1}	δ_2	δ_1	δ_0	δ_{-1}	δ_{-2}
Empirical designation		p_a	p_b	z	x	y	d_b	d_a
σ	0	1	1	0	1	1	2	2
ρ	1	0	-1	2	1	0	-1	-2

The connexion of the Greek letters used in designating the terms with the values of l and σ is evident (Mulliken uses S, P, D instead of Σ, Π, Δ). In the He_2-molecule only the terms which are antisymmetric in the nuclei are present They can only have odd values of $j-\rho$. Therefore, also in case I, j is odd for even values of ρ (index a) and even for odd ρ (index b).

In the 3δ-complex, case I is realised for small values of j. This means we must use the σ-classification and have the normal type of transitions studied especially by Mulliken We have here $\Sigma \longrightarrow \Pi$, P-, Q-, and R-branches, $\Pi \longrightarrow \Pi$ only P- and R-branches, and $\Delta \longrightarrow \Pi$, P-, Q-, and R-branches. That is in exact agreement with the observations For larger values of j the coupling of l with the internuclear axis becomes looser, which is shown by a shift in the energy levels and the appearance of Q-branches in the $\Pi \longrightarrow \Pi$ band At the same time the P-branch of the $\Sigma \longrightarrow \Pi$ band disappears and the Q-branch becomes much weaker The behaviour of the separate energy levels is represented by formulæ obtained in the same way as those of Hill and van Vleck

The $2p$-4δ complex, which is also completely known, shows that the 4δ-terms are also for small values of j in the transition stage between cases I and II. Whereas the energy of the separate terms becomes a complicated function of j, the theory shows that the mean values of δ_1 and δ_{-1} and those of δ_2, δ_0, and δ_{-2} behave like the energy of a $\sigma\Sigma$-term which can always be represented by a simple quadratic expression in j. That is in excellent agreement with the observations, and the molecular constants can easily be calculated in this way

For the 5δ and 6δ complexes the observational data are not yet entirely complete. But the existing data show that stage II is reached already for very small values of j. The anomalous energy values have disappeared. The nuclear moment of momentum is again an integration constant and ought therefore only to change 0 and ± 1 in a transition. That means that for the combination of a δ_ρ-term with the $2p$ level which is in stage I., we get the following branches.

Initial term .	δ_2	δ_1	δ_0	δ_{-1}	δ_{-2}
Branches .	R	R, Q	R, Q, P	Q, P	P
Appearance .	P	Q, P	R, Q, P	R, Q	R

So far as the data permit this to be tested, it was found to be in agreement with the facts

The transition stage of the π-terms is analogous, though much simpler, owing to the fact that there are only three of them, and because the one with $\sigma=1$

and $\rho=0$ ($\pi\Pi_a$, the term which gives the Q-branches in the $s \rightarrow p$ bands) behaves like a $\sigma\Sigma$-term.

The constants $B=\frac{h}{8\pi^2 I}$ and A, which expresses the degree of coupling of the vector l to the internuclear axis, for the most important terms are

	2π	3π	4π	3δ	4δ	Par 3δ
A	8890	2971	1482	165	75 06	132
B	7 336	7 173	7 130	7 072	7 088	7 079

For the degree of accuracy, way of calculating, etc , I must refer to the full paper which will be published elsewhere and will contain all the details The ideas expressed in the present note have also proved fruitful for the understanding of the spectrum of the hydrogen molecule.

G. H. DIEKE.

Natuurkundig Laboratorium der Rijks-Universiteit, Groningen.

Elastic Collisions of Electrons with Helium.

IN view of the recent experiments of Dymond and Watson on the scattering of electrons in helium (*Proc. Roy. Soc*, vol. 122, p 571), it has been of interest to work out the scattering predicted by the wave mechanics. The method used is that of Born (*Gottinger Nachrichten*, p 146, 1926), and involves two separate approximations In the first place, we neglect the polarisation of the atom by the incident

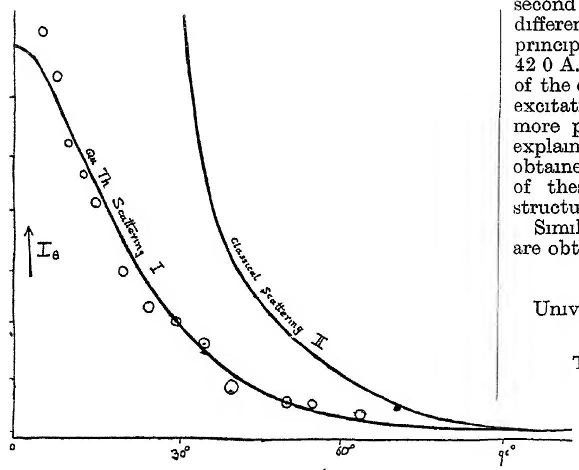

FIG 1 —Elastic scattering of 210-volt electrons by helium Experimental readings fitted at 30° are indicated by O.

electron, the atom being treated as an electrostatic centre of force We have used the field calculated for helium by Hartree (*Proc Camb Phil. Soc.*, vol 24, p. 111) Secondly, we have calculated only the first approximation of Born, which is sufficient only if the de Broglie wave-length of the incident electrons is large compared to the classical distance of closest approach Neither approximation will introduce a serious error if the energy of the incident electrons is large compared to the ionisation energy of the atom. For 200-volt electrons the error should not be greater than about 20 per cent

Fig. 1 shows the variation of scattering with angle to be expected for elastic collisions with 210-volt electrons. I_θ is the scattering per unit solid angle. Curve I gives the quantum theory scattering, and curve II the classical scattering by the Hartree field of the atom. The two curves lie close together for large angles, where the scattering is mainly nuclear. For small angles there is a marked difference, the classical I_θ becoming infinite for θ equal to zero, as the following table suggests

θ	3 3°	5 7°	19°	30°	44°
I_θ (classical)	190	54	2 1	0·81	0 26

It is not true, as is often stated, that the scattering integrated over all angles is the same both classically and on the quantum theory.

The results of Dymond give relative scattering only, and we have therefore fitted our curve and his readings at 30° Considering the approximate nature of our calculations, the agreement is as good as can be expected. It is obvious that the experimental readings could not be fitted to the classical theory curve.

An account of these calculations will be published shortly, in which it is hoped to consider also inelastic collisions

N F. MOTT.

St John's College, Cambridge.

Densitometric Measurements of the K-α Line of Carbon.

(BY CABLE)

DENSITOMETRIC measurements of the K-α line of carbon in three orders obtained with a grating having twelve hundred lines per millimetre show distinct, clearly measurable separation of components in the second and third orders, wave-lengths checking in different orders and on different plates. There are four principal components in the main line at 44·2 A., 42 0 A., 45·4 A., and 46·15 A. The relative intensities of the components apparently depend on conditions of excitation, some of the longer components becoming more prominent at higher driving potentials, thus explaining the divergence of wave-length values obtained by other observers in the third order. Some of these components apparently have a doublet structure.

Similar but broad and more complex separations are obtained in boron K-α.

C. B. BAZZONI.
...FAUST.
...WEATHERBY.

University, Pennsylvania, April 24

The Assembling of Male Moths due to the Sense of Smell.

DR. ERNEST WARREN, in his interesting letter published in NATURE of Feb. 23 (p. 278), suggests that the assembling of male moths around the female is evidence for the existence of "recondite influences". It is, however, clear that the flight of the males is stimulated and directed by air-borne odoriferous particles, which, however, have no effect upon the human olfactory sense. If a virgin female of certain moths, such as the Oak Egger, be carried in a closed box, males are not attracted, but they begin to assemble directly the cover is taken off. Furthermore, the box itself may continue to attract for some days after the female has been removed. Porous substances continue to be attractive longer than dense ones. Such 'assembling' males possess wide-spreading antennæ, adapted to comb the air during their rapid, characteristic flight, which is such as to test a large cross-section as they proceed Some of the detailed evidence that the attraction is due to scent has been brought together in the *Proceedings of the Entomological Society of London*, vol. ii. 1927–28, pp 75-82.

EDWARD B. POULTON.

Oxford, Mar. 29.

Physics in Relation to Oil Finding.[1]

By Prof. A O. RANKINE.

F a time-graph is plotted, with the intervals between the instant of explosion and that of *initial* disturbance of the seismograph as ordinates, and the distances between explosion and seismograph

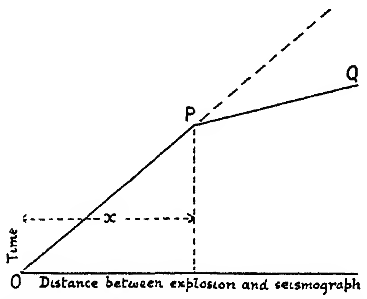

FIG. 2.—Time-distance graph corresponding to Fig 1 x is the distance at which direct and indirect disturbances arrive synchronously.

as abscissæ as in Fig. 2, it will display a break (at P) where the times of arrival of direct and indirect disturbances are equal Actually the distance x for time equality is related to the depth of the interface by the relation

$$\frac{h}{x}=\frac{1-\sin\theta_c}{2\cos\theta_c}$$

Moreover, the slope of OP, which corresponds to the direct disturbance, is proportional to $1/V_1$, while the slope PQ, which relates to the indirect disturbance, is proportional to $1/V_2$ Thus $\sin\theta_c = V_1/V_2 =$ (slope of PQ)/(slope of OP) Hence θ_c is determined, and its insertion in the above equation, together with the value of x read from the graph, enables the depth h of the interface to be calculated

Owing to its relatively large magnitude, it is possible to recognise on the seismograms the arrival of the direct disturbance even when it reaches the seismograph *after* the indirect disturbance This corresponds to the dotted portion PR of the curve, or OP produced

This simple case is merely an illustration. Many others have been worked out, such as those corresponding to more than one stratum, sloping strata, or interfaces which abruptly change depth. To deal with these here would lead us too far In all cases the procedure has to be the assumption of various possible underground structures until one is found which by calculation agrees with the time-graphs actually obtained For this purpose it is frequently necessary to multiply observations by changing the position of the explosion point and the direction of the line of observation The accumulation of field data over various structures also obviously facilitates the recognition of similar structures in subsequent surveys

It is only possible to deal very briefly with field procedure. Where, as often happens, the salt-domes or limestone anticlines are deeply buried, large charges must be exploded because of the long ranges which must be covered to reach and pass beyond the point of time equality—an essential condition if the depth is to be determined Consequently it is economical to multiply the number of seismographs used rather than the explosions For celerity of survey the seismographs must be readily portable and easily set up in their new positions In the early days of this work the instant of explosion (necessary for the calculations) was deduced from the position of the air-borne

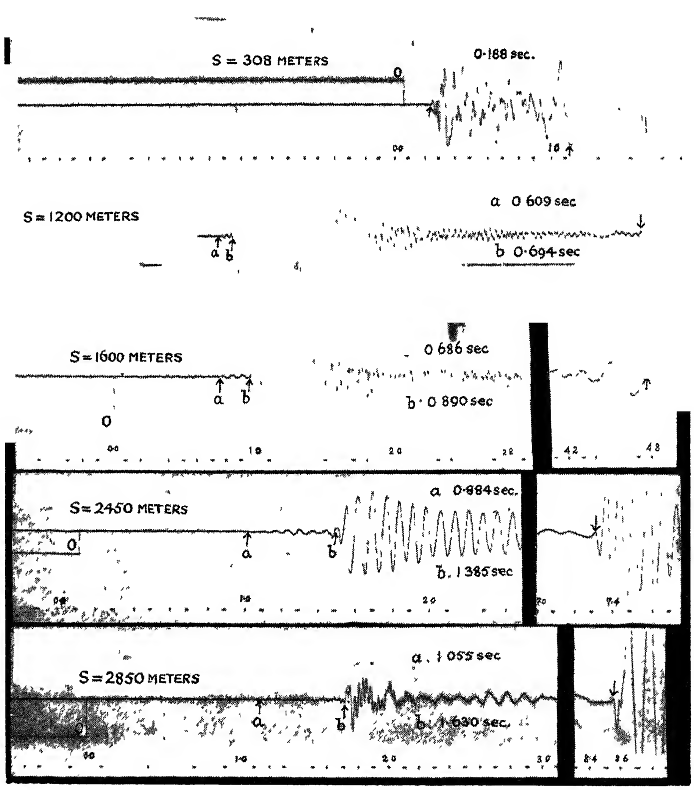

FIG. 3 —Five seismograms obtained on an observation line over a salt dome Dots at bottom of each are made by time marker, interval being $\frac{1}{10}$ second

[1] Continued from p. 686

disturbance on the seismogram, assuming the value of the velocity of sound in air This in practice is often the largest effect recorded, but it arrives much later than the earth-borne vibrations This method, which is rather inaccurate on account of the wind and temperature corrections, has now been superseded by including with the recorder an oscillograph which places on the record a wireless signal actuated by the breaking of an electric circuit by the explosion itself The recorder includes a time marker which enables the transmission times to be estimated with sufficient accuracy. Photographic recording is ordinarily used I have seen a troop of observers of the Geophysical Company, Ltd, operating this system in the Anglo-Persian oil-fields, and have nothing but admiration for the celerity and efficiency with which the field work is carried out

Through the courtesy of the Geophysical Company, Ltd., it is possible now to publish for the first time a group of five seismograms obtained with Mintrop seismographs (which record vertical movements of the earth's surface) over a salt-dome. These are shown in Fig 3, and exhibit the various effects to which reference has been already made Each shows (at the point *O*) the wireless signal of the explosion, and the final effect of the air-borne wave, in some cases so large as to make the detail of the trace invisible In the last three records a piece has been cut out so as to bring this effect within the scope of the diagram The earth-borne disturbance, which lies between the wireless signal and the air wave, changes in type as the distance is increased The indirect disturbance, which is not visible in the first seismogram at 308 m., makes its first appearance in the second at 1200 m, as a small vibration preceding the much larger direct disturbance In the next two, at 1600 m and 2450 m, the time interval between the indirect and direct disturbance has increased progressively in magnitude, while in the last, at 2850 m, the time difference is approximately the same as in the one just previous

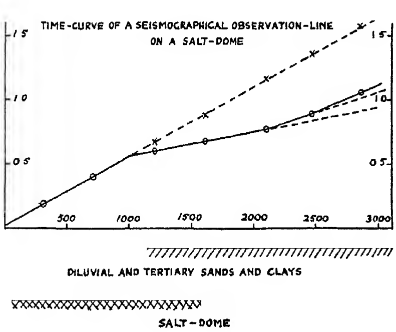

FIG 4 —Time-distance graph corresponding to seismograms in Fig 3

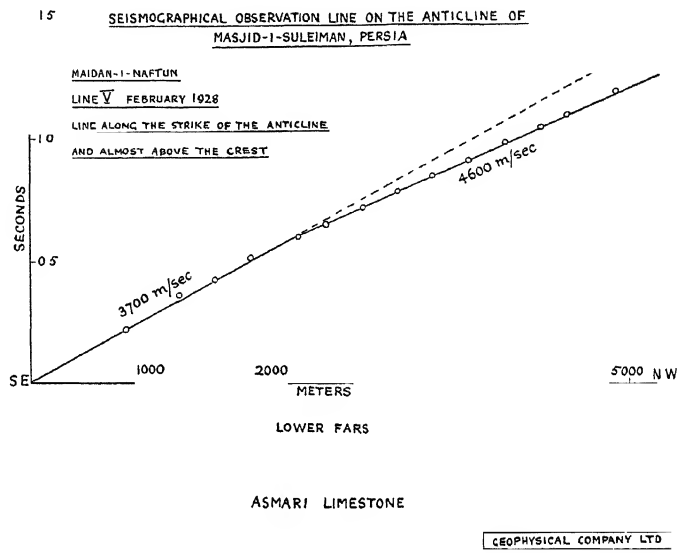

FIG 5

The time-graph in Fig. 4, which includes points from other seismograms besides those shown in Fig 3, exhibits the results graphically It shows unmistakably, at a range of about 1000 metres, a discontinuity of the kind mentioned in an earlier paragraph, and the two different slopes before and after this point. There is displayed besides the ultimate tendency of the curve to resume its initial slope—a feature known from theoretical considerations probably to signify a dipping of the interface The depth, and roughly the shape and location of the edge of the salt-dome have thus been deducible, and are shown in the lower part of the diagram

Time-graphs of the same general character relating to the great limestone anticline, from which most of the Anglo-Persian oil is at present drawn, are shown in Figs 5 and 6 The survey in this region was carried out for the Anglo-Persian Oil Company, Ltd, by the Geophysical Company, Ltd, and really constituted a test of the efficacy of the seismic method over a region where the general features of the limestone structure were already known as a result of extensive drilling. Fig 5 relates to a direction of observation parallel to the long axis of the anticline and Fig 6 to a traverse across it. The conditions were much less favourable than over salt-domes, owing to the depth of the limestone and to the relatively small difference of velocity as between the limestone and the Lower Fars with which it is covered. This is indicated in the time-graphs by the smallness of the changes of

slope in the curves Nevertheless, the method, which had previously been applied extensively and successfully to the location of salt-domes in Texas, proved of value in Persia also, the limestone depths being measured to an accuracy of 10 to 15 per cent There are, therefore, good grounds for confidence that the surveys being carried out by the Geophysical Company, Ltd, on similar structures of unknown shape in other regions of Persia and in Iraq will provide the data required for successful drilling for oil.

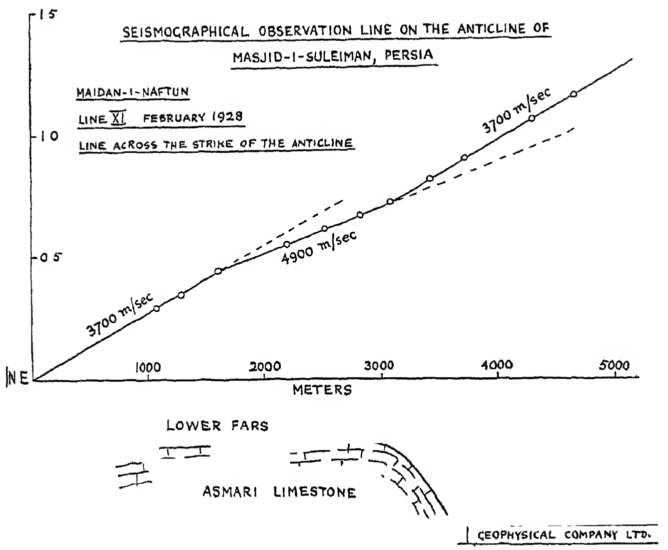

FIG 6

For descriptions of portable seismographs the reader must be referred elsewhere, for example to the recently published translation of Dr. Ambronn's book,[2] which contains the original references

[2] "Elements of Geophysics" By Dr Richard Ambronn, translated by Margaret C Cobb (London McGraw-Hill Publishing Co, Ltd)

Mintrop's seismograph, with which most of the seismic surveying has been done, is one in which the magnification of the earth's movement is secured partly mechanically and partly optically. There are others of the same type, notably Schweydar's, which records also horizontal movements Another type employs electrical magnification, as in Dowling's and Ambronn's instruments It is doubtful whether any of them imitates precisely the movements of the earth's surface, but so long as it is merely a question of determining the instant of first arrival of the disturbance, this is of no great importance It is nevertheless worthy of note that the production of an exact recorder will open new lines of attack on the problem, such as the determination of the angles at which the disturbances arrive at the earth's surface

Progress is being made in the gravimetric and seismic methods of survey, both as regards improvements of the instruments themselves and the technique of procedure in the field and in interpretation In this matter Great Britain is much behind-hand, and it is hoped that this article may contribute to the stimulation of that interest which is essential to progress

I desire to express my thanks to the Anglo-Persian Oil Company, Ltd., and to the Geophysical Company, Ltd, for approving and facilitating the publication of this article I am specially indebted in this respect to Prof Mintrop, and to Mr. Ernest H. Neville and Dr Schmidt of the latter Company.

The Centenaries of Davy and Young.

IN the National Portrait Gallery hangs the well-known composite portrait group of eminent British men of science who were alive in 1807–8, the group being shown assembled in the Library of the Royal Institution. There are forty-eight portraits in all, including those of Banks, Watt, Rumford, Jenner, Herschel, Cavendish, Telford, Trevithick, Wollaston, Dalton, Davy, and Young. The oldest represented in the group was Matthew Boulton, the partner of Watt, who was born in 1728, while the youngest was Davy, born just fifty years later, in December 1778.

No more appropriate setting could have been found at that time for such a group, for though at its birth the Royal Institution had for its sponsors many notable men of the day, its infancy had been a somewhat precarious one, and it was mainly through the talents of Davy, then probably at the height of his powers, that it had been rescued from the uncertainties which had threatened its very existence. It had been raised to a foremost position among scientific institutions, where not only the learned, but also the fashionable and the great, gathered to see the striking experiments of Davy and to listen to his brilliant discourses from which we are told Coleridge increased his stock of metaphors

Founded in 1799 through the exertions of Rumford, the Royal Institution had already counted among its first professors Garnett and Young, but it was the lectures of Davy which marked the beginning of the popularity it has since enjoyed and the reign of discovery with which its name is linked. After Davy came Brande, Faraday, Tyndall, Dewar, and others, and in "Britain's Heritage of Science" we are told "there is no

building in the world associated with so many classical and revolutionising researches as that in which the Royal Institution is housed."

If the setting for this remarkable group invites our approbation, no less does the date of its execution appeal to our sense of historic fitness. The early years of the still young century had been full of promise, and though owing to the ambition of Napoleon few nations were free from the threat of war, scientific and industrial development was proceeding apace, and the very names of Cavendish, of Herschel, of Watt and of Trevithick recall the pioneering work and the planting of the seed from which our later harvests have come. At home and abroad, science in 1807 was engaging some of the keenest minds. The guillotine, it is true, had robbed France of her greatest chemist, but she still counted among her veterans, Laplace and Lagrange, Legendre and Coulomb, while following in their footsteps came Fourier, Biot, Ampère, Malus, Arago, and Fresnel.

As in France, so in Europe generally, science and invention were bearing good fruit. Astronomy had been enriched by the discovery of Ceres, Pallas, Juno, and Vesta; Volta's great invention of the electric battery was being applied in a hundred experiments; Chladni had made the world his debtor by the publication of his work on acoustics, while Oersted had begun his work at Copenhagen, where he was destined to make his great discovery of electro-magnetism. To the particular years 1807 and 1808 belong the publication by Thomson of the atomic theory of Dalton, the publication of Young's "Lectures on Natural Philosophy", and the memorable experiments of Davy leading to the isolation of sodium and potassium.

However interesting a review of the science of that time may be, our immediate attention is naturally directed to the careers of Davy and Young, both of whom died in May 1829, a hundred years ago, Young passing away on May 10 and Davy on May 29; Young being then but fifty-five and Davy only fifty years of age. Strangely unlike in temperament, in character, and in their reaction to the buffets and rewards of life, they yet present many interesting parallels as well as contrasts. Even Galton would, perhaps, have found it hard to determine the influence of heredity on their careers; for Davy was but the son of a woodcarver of Cornwall, and Young the son of a Quaker landowner of Somerset. In neither instance, also, did early training have much to do with their subsequent successes. The astonishing precocity of Young was equal to that of a Macaulay or a Rowan Hamilton, and as a boy of fourteen years of age he was acquainted with Latin, Greek, French, Italian, Hebrew, Persian, and Arabic. Davy had a mind equally alert and a memory equally tenacious, but he enjoyed fewer advantages than Young, and it was to a Quaker saddler friend and a self-appointed guardian that he owed the encouragement and assistance without which, perhaps, his genius might have led him to less congenial pursuits. Young was the senior of Davy by five years, and while Davy was serving his apprenticeship to the Penzance apothecary and surgeon, Borlase, Young was leisurely following his academic course in medicine at Edinburgh, Gottingen, and Cambridge, where his learning led to his being known as "Phenomenon Young".

It was in 1801 that the paths of these two extraordinary men met, the older one becoming the professor of natural philosophy and the younger the professor of chemistry in the newly founded Royal Institution. Davy's first lecture was given on April 25, 1801, Young's first lecture on Jan. 20, 1802; but whereas we are told Young found "the number of his attendants diminish daily, and for no other reason than that he adopted too severe and didactic a style", Davy filled the theatre to overflowing, where "his youth, his simplicity, his natural eloquence, his chemical knowledge, his happy illustrations and well-conducted experiments excited universal attention and unbounded applause".

Of the details of the work of these illustrious investigators many accounts have been given. His experiments with nitrous oxide, his isolation of sodium and potassium and other elements, and his invention of the miner's safety lamp are but a few of the outstanding achievements of Davy, whose name was as familiar in France and Italy as it was in England. His invention of the safety lamp he made a free gift of to mankind, and the silver plate presented to him by the colliery owners in recognition of his work was long since sold and used for founding the Davy Medal of the Royal Society. Young's work illustrates the versatility of his rare mind. His most notable contributions to science were concerned with optics, the strength of materials, and elasticity. The first definitions of 'energy' as we understand it and of 'Young's modulus' are to be found in his "Lectures". His views and discoveries in light were fundamental, and he has been called "the founder of physiological optics". Of Young, Helmholtz said: "He was one of the most clear-sighted of men who ever lived, but he had the misfortune to be too greatly superior in sagacity to his contemporaries. They gazed at him in astonishment, but could not always follow the bold flights of his intellect."

Known widely for their writings, their lectures, their researches, and discoveries, Young and Davy are also remembered for the work they did in connexion with societies, committees, and institutions. Both were foreign associates of the Paris Academy of Sciences, both held secretaryships of the Royal Society, of which Davy was the twenty-fourth president, while Young was long physician to St. George's Hospital. The grave of Young is at Farnborough, Kent; that of Davy in a cemetery outside the city of Geneva. There is a statue of Davy at Penzance, a marble bust of Young in the Shire Hall, Taunton, while each is commemorated by a memorial tablet on the walls of St. Andrew's Chapel, Westminster Abbey. Such memorials, however, may crumble and perish, but the work of Young and Davy will endure for ever; for as Davy said when presenting the Copley Medal to Arago: "Science, like Nature, to which it belongs, is neither limited by time or space. It belongs to the world, and is of no country and no age."

Landscape at the Royal Academy.

By Dr. VAUGHAN CORNISH

THE representation of the vibrant effect of sheer sunlight is a relatively modern achievement in painting, which has, however, passed through the experimental stage, and is well given in Mr H. H La Thangue's two pictures, Provençal Workers (34) and A Provençal Forecourt (488), and vibrance is well combined with the complementary colouring of sunlight and shadow on the white walls of the Farm near Sospel by Mr St Clair Marston (614) It is, however, from our own Cornish coast that Mr Julius Olsson chooses his examples of moonlight on the waters, the acme of contrast in tone in an almost monochromatic scene which never fails to touch the chords of emotion. The subjects are St. Anthony Light (176) and Herring Fleet St Ives (500).

Sunlight and shadow on the waves are rendered in George F Bradshaw's At Sea (1) and on the irregular surface of snow by Donald H. Floyd, Sunshine after Snow (131). Circumambient colour of sea and sky is effectively accentuated by its concentration and massing on hull and sails in Mr Arthur J. W Burgess's Gipsies of the Deep (357) and Pleasure Afloat (281) For the blue depths of atmospheric colour our painters have relied upon the mountain background, as in Lakeside (571) by Sydney V North and in Mr E L. Lawrenson's picture of the remote Achill (153) where, as in Skye, some peculiarity of insular climate beside the western ocean dyes the distant hills in deepest purple.

For catching the moods of the mountains as determined by weather and season, a very mirror of the moods of man, the method of water-colour has advantages, and the enlarged space now given to the water-colours at Burlington House is therefore welcome to the student of Nature, as is also the allotment of a fine spacious gallery to the drawings, engravings, and etchings, among which are many interesting landscapes Mr Alfred Hartley's aquatints, A Storm on the Alps (1082) and Morning Haze on a Swiss Lake (1070), are the reward of those who watch and wait among the mountains. In Mr Percival Gaskell's aquatint, On the Lake of Thun (1130), looking west across the water towards the Stockhorn range, the suffusion of afternoon light enables the artist to unite the boldness of the peaks and the repose of the lake, the combination which so greatly contributes to the delights of residence in Alpine lakeland In Mr B. Eyre Walker's aquatints, October Snow, Windermere (1126), and the tiny Autumn Snow on Coniston (1156), we are pleasantly reminded of the beautiful aspect of the English Lake District, when the peaks are emphasised by snow caps, while Sir D. Y. Cameron's wash drawing Cluanie (1034) indicates admirably the way in which the re-entrant line of the lake shore, stronger in tone than the skyline, imparts an appearance of ordered grouping to the surrounding mountains

For landscapes which derive their motive in the cyclopæan masonry of rock structure, we must return to the oil paintings In Pordenick, Land's End, by Charles W S Naper, the strongly jointed rock has a pattern of vertical and horizontal lines so easy for the eye to grasp that the strength of the cliff in no way impairs the sense of repose imparted by the calm sea from which it rises sheer An effect not altogether dissimilar may be seen where church towers rise above the flat expanse of the Fen Country Mr John H Willis's In the Nant Ffrancon Pass (403), one of the few large landscapes, is a fine study of a rhythm of rock structure more exciting to the eye, spiked, pyramidal The colouring of this landscape, whether determined by preference or the chances of the season, is not that which best concords with the forms of this district, but we can find satisfaction in Miss Judith Ackland's Snowdon by the Pen y Gwryd Track (647), in which tone and colour convey the solemnity of Snowdonia Other artists seek, I infer, to enhance the abstract quality of strength in mountains by stripping them of atmosphere so that the whole structure, including the serrated skyline in the distance, has a texture comparable to that of a rocky foreground Such appears to be the intention in The Pillars of Heaven (284) and Mountains of Murcia (611) by Mr Guy Kortright, and a somewhat similar treatment is found in The Alps from Sallanches by Mr R. M. Hughes (160) These studies are in full daylight If it be permitted to a fellow student of mountain beauty, though not a fellow artist, to offer a suggestion, I would venture to cite my experience that in certain types of weather the hours of dawn show the high mountains in a strength of tone rivalling lunar landscapes combined with such conditions of colour as would assist the abstract treatment of massive effect.

Among the studies of Arcadian England, there is one of special charm which is likely to escape notice on account of the fact that it is almost the smallest picture in the Exhibition, Miss Dorothy M. Snow's water-colour, A Sussex Farm (788) It shows that neatness of agricultural landscape which astonishes the visitor from the New World, causing him to exclaim, as I have myself heard, that "this country is a garden" The smoothly rounded lines of the topography of the southern and midland counties of England, and the rounded forms of their spreading, broad-leaved trees, make difficult the task of harmonising architecture with the landscape, but in the barren and rocky lands of the Spanish *meseta*, architecture carries the forms of natural landscape to a culmination, as is shown in Mr Oliver Hall's important picture, A Spanish Bridge (86), which gains in effect from its suitable frame of black and gold. Among the water-colours, Mr Cecil A. Hunt's Gorge of the Tagus, Toledo (764), also deals with an architectural culmination of rocky form. At the present time, when controversy is so keen on the subject of styles of construction considered in relation to the amenities of the countryside, it is important that we should

(*Continued on p.* 731)

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The Maintenance of Life and Irritability in Isolated Animal Tissues.[1]

By Prof A V. Hill, F R S

NOT infrequently one hears the view expressed that physiologists are too ready to work with isolated tissues, not willing enough to study the intact and living animal The isolated organ is said to be 'abnormal', its behaviour too remote from that of its previous self, in its usual environment, to throw much light upon the normal processes of life There is indeed a danger that those who work under artificially simplified conditions may, in their enthusiasm, extend their results too far the greater danger—I speak with feeling—is that their friends, and the daily Press, may do so for them If you describe how a nerve-fibre maintains the electrical potential difference at its boundary by an active process involving the consumption of oxygen, you may find your name in all the newspapers, and be invited to America to raise people from the dead if you prove that chemical disintegration sets in, in a stimulated muscle deprived of oxygen, you may be charged with attempting to create a living cell (and indeed a living 'soul') in the laboratory

Realising this danger, however, appreciating that only after hard and critical thinking may the results of laboratory work under simplified conditions be applied to the graver practical problems of life, we may—in fact, we must—go forward in the confident belief that only by investigating phenomena under such simplified conditions can we really hope to understand them

Here, to the scientific mind, is in fact a definite and presumably soluble problem, that provided by 100 mgm or so of isolated muscle or nerve, capable of responding in a regular and reproducible manner to certain treatment academic—certainly: so was the study of the conduction of electricity through gases—until it led to X-rays and amplifying valves abnormal—if you like but still a fact, and one that presumably can be explained The irritability, the responsiveness, of this little bit of surviving tissue can be maintained, under conditions which we are beginning slowly to understand, for considerable periods and during all this time we can study the processes of life, in abnormal form if you wish, but still as phenomena, as facts, under conditions which allow us to apply the methods of physics and chemistry as we could never hope to do in the normal intact animal

ENERGY EXCHANGES IN NERVE

The isolated nerve of a frog, placed in an appropriate salt solution containing oxygen, will live, or at any rate continue to function, for days We can detect its activity most readily by leaving it connected to a muscle, which will twitch when we stimulate the nerve A better method, since it involves the properties of the nerve alone, is to record the 'action current', which passes for a few thousandths of a second between electrodes placed upon its surface Another method, but more difficult to apply, is to measure the heat produced by the nerve when stimulated.

For long periods the surviving nerve will show all the outward and visible signs of a response to stimulation During prolonged survival at rest it consumes oxygen and gives out carbon dioxide. at 20° C about half a cubic millimetre per gram per minute, more at a high temperature, less at a low During maximal activity, due to continual stimulation, its metabolism is doubled, its oxygen consumption at 20° C is about one cubic millimetre per gram per minute. It gives out corresponding heat. Of this heat, only about one-tenth appears during the passage of the impulse—the rest comes off slowly, during the following fifteen minutes . clearly it is related to some recovery process, by which the nerve is 'recharged', by which its potential energy, so to speak, is restored.

The fact that extra oxygen is used as the result of activity is, in a sense, easy to understand Breakdown has occurred, free energy has been liberated, and if the process is to be reversed, oxidation is necessary to supply the free energy required in the re-synthesis The oxygen consumption at rest is much more difficult to comprehend. Why should

[1] From the Ludwig Mond Lecture delivered at the University of Manchester on Mar 6

an isolated tissue, doing nothing at all except continuing to exist—that is, continuing *to be ready* to respond to a stimulus—require what is in fact a considerable amount of oxygen, three-quarters of its own volume per day at 20° C, three to four times its own volume at human body-temperature? Energy, we may say, is required to maintain the organisation In what manner, however, is the energy being applied? What will happen if the supply of oxygen be stopped?

The last question is very readily answered by experiment The air around the nerve is replaced by pure nitrogen, and from the known diffusion constant of oxygen and the known oxygen consumption of the nerve, we can calculate that in a very few minutes not a trace of molecular oxygen is left A stimulus is applied at intervals, and the action current, or the heat, is used as a sign of activity. At first no particular change occurs the nerve responds as before Long after *all* the molecular oxygen is gone, action current and heat-production remain almost unaltered Even the recovery heat, which surely is of oxidative origin, is unaffected Presumably there is some source of intra-molecular oxygen, or some store of hydrogen-acceptor, which, for a time, can supply the energy required for recharge Gradually, however, a change comes on action current and heat diminish, and in two hours after the oxygen was removed they disappear together

The nerve, however, is not dead. let oxygen in and it revives. its return is gradual, much slower than the inward diffusion of the gas—the oxygen clearly has some duty to perform, some debt to pay, before the situation is cleared up The nerve asphyxiates much quicker a second time if its exposure to oxygen be cut short. Indeed, by the admission of oxygen alone, complete recovery from asphyxia is not possible. however long be the exposure to oxygen, subsequent asphyxia (as Gottschalk showed) is quicker than it was originally Washing the asphyxiated nerve with *oxygen-free* salt solution restores it temporarily. Complete restoration, however, is attained only if washing be combined with oxygen. Then the nerve returns triumphantly to its full initial activity, apparently unaffected by the intervening period of asphyxia. It seems as though, in the absence of oxygen, two things have happened: (*a*) some metaphorical accumulators have run down and need recharging—a process which requires oxygen; and (*b*) certain abnormal substances have appeared, which cannot be removed by oxygen, but will diffuse away into surrounding salt solution.

Potential Differences in Nerve

Many attempts have been made in recent years, before the latest and most successful ones, to measure the gaseous exchanges of isolated nerve Actually in the refined methods employed by Meyerhof and by Warburg, modifications of those of Barcroft, a means has long been available of making these important measurements When Downing and I succeeded at last in measuring the heat-production of nerve, it seemed to us, and to Gerard who had joined us, that corresponding determinations of oxygen consumption should be carried out I wrote, therefore, to Meyerhof and asked him if Gerard could come to make these with him Meyerhof waited a day to reply. his answer was, as I expected, "Of course, let Gerard come", but also, as I had not expected "es ist ausserordentlich leicht, I did it yesterday on the receipt of your letter". So Gerard went and made the experiments in Berlin At the same time Fenn was doing the same thing in his laboratory at Rochester, New York The oxygen consumed at rest, the oxygen needed for activity, and finally, the oxygen required for recovery from asphyxia, were all measured and are now tabulated for those who need to use them for their calculations

I mention these measurements partly for their own sake—as the happy ending to a long series of persistent attempts—but more particularly for a curious by-product which, like many by-products, is likely to prove more important than the original object An American worker, some years before, attempting to measure the carbon dioxide production of nerve, had employed a very convenient object, the limb nerve of the spider crab Reading his paper I noticed that, whereas he had stimulated the nerve for long periods, he gave no evidence that the nerve had really responded at all to his stimuli Knowing from experience of medical practical classes how often nerves do not respond to the best-intentioned stimuli, I thought I had better try for myself So, being at Plymouth, where there are much bigger and better spider crabs than in America, I tried, and by good fortune a whole beautiful new field of work appeared

The experiment was a simple one A and B are two non-polarisable electrodes placed upon the nerve, which for the sake of the argument we take as a single nerve fibre A is at an uninjured point, B at the cut and injured end. A and B are connected to a galvanometer. A difference of potential exists between A and B, the so-called injury potential, which produces what is called the 'demarca-

tion current ' when it is allowed to flow through the galvanometer. *A* is positive to *B* in the external circuit. When we apply an induction shock to the nerve at a distant point *C*, the potential difference between *A* and *B* momentarily falls as the impulse passes *A*: the current through the galvanometer diminishes: we witness what is called the ' negative variation of the injury current '. If we apply a succession of induction shocks at *C*, each produces its effect at *A* as its corresponding impulse goes by, and if the galvanometer be a relatively slow one, these effects are summed up, and as we continue stimulating, the galvanometer returns

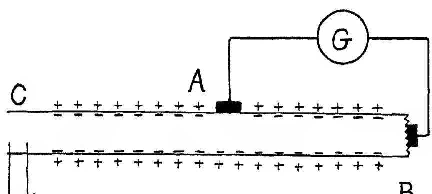

Fig. 1.

towards its zero, deflecting again when the series of stimuli ends. Such, at any rate, is what happens in a frog's nerve. The fact has been known for two generations: it is demonstrated to students: but curiously enough—so far as I am aware—nobody had ever tried to show it in a crab's nerve. In that tissue, if stimulation be continued long enough—for a minute or two—the galvanometer does indeed move backwards during the stimulus towards its zero, recording the usual ' negative variation ', but it does not return outwards again when stimulation ends.

Let me pass for a moment to a fact recently established by Furusawa. If a crab's nerve be kept in air in a moist chamber, the difference of potential between *A* and *B* is maintained for long periods. If, however, the air be replaced by pure nitrogen, the difference of potential between *A* and *B* gradually diminishes. On introducing air again it rises to its original value, not immediately but in an hour or so. Clearly, oxygen is being used to maintain a potential difference somewhere within the nerve. Where can this potential difference be other than at the surface of the fibre itself? At the cut end the electrode is in contact with the naked protoplasm of the cell: at the uninjured point the electrode is in contact with the outside of the membrane surrounding the tissue. We must imagine that the injury potential is really the difference of potential across the membrane of the nerve fibre, the contents of the fibre between *B* and *A* simply acting as a continuation of electrode *B*. Apparently, then, Furusawa's observation shows that the potential difference existing across the membrane bounding the nerve is maintained by oxidation, and gradually ' runs down ' if oxidation be prohibited.

Picture the passage of the impulse along the nerve as being momentarily accompanied by a breakdown, or maybe a short-circuit, of the membrane, perhaps by a change of permeability allowing local currents to run and so to propagate the impulse. Thinking of the membrane as similar to an accumulator of small capacity, a series of such momentary short-circuits might ' depolarise ' it, so that by stimulation we might effect a decrease in the observed injury potential. Now Levin found, and Furusawa has confirmed the fact, that a prolonged stimulus applied at *C* causes a return of the galvanometer towards its zero, which is not followed by a deflection outwards again when the stimulus ends. Furusawa, moreover, has proved that if local fatigue at the point of stimulation be avoided by employing, in rapid succession, a series of such points, the nerve can be *completely depolarised by activity*. The ' accumulator ' which lies along the bounding membrane of the nerve fibre can, it seems, be caused to run down completely by prolonged activity. Let us now withdraw the stimulus and wait. If the nerve be in air, the potential difference between *A* and *B* gradually rises again until finally it attains its original value. This is the recovery process to which I referred earlier. If, however, the nerve be in nitrogen, it remains depolarised and further activity is impossible. The potential difference existing across the boundary of the living cell is not only maintained but also restored by an active process of oxidation.

Osmotic Differences in the Egg.

In a recent paper from Holland by J. Straub, an investigation has been described of the difference of salt concentration, and of freezing-point, between the white and the yolk of an egg. It appears that, in the living fresh egg, there is an appreciably higher concentration of potassium, sodium, chlorine, and lactate ions in the yolk, and an excess lowering of freezing-point of about 0·15° C. In preserved eggs this difference is much less. The membrane surrounding the yolk is apparently freely permeable to water, even in its live condition, and the difference of freezing-point on the two sides is much too large to be accounted for by any such effect as that of the Donnan equilibrium. A difference of freezing-point of 0·15° would correspond to a difference of pressure of 1·8 atmospheres, and it is inconceivable

that a thin membrane so extensive as that surrounding the yolk could possibly stand a pressure such as this.

It is difficult to resist the conclusion that the existence side-by-side of white and yolk cannot be regarded as a thermodynamic equilibrium, and Straub suggests that the difference of concentration on the two sides of the membrane is maintained by an active process of oxidation. It is known that oxidation occurs in the living egg, and, according to a rough calculation, the amount of energy supplied thereby is ample to account for any osmotic work that would have to be performed to maintain, against diffusion, the observed concentration differences. It is suggested that the observed inequalities in concentration and in freezing-point must be due to some active life process, and the author discusses an electrical scheme for the employment of the energy obtained by oxidation in the egg. He supposes that the membrane acts as a galvanic oxidation element for glucose, and that the difference of potential so set up across the membrane results in the transfer, against diffusion, of the various positive ions in question. Such a galvanic battery existing across the membrane, together with differences in permeability, might be a sufficient explanation of the inequalities observed. A large number of physiological phenomena would be more intelligible were we able to suppose that oxidation at the surface of a cell is largely employed in maintaining the osmotic and other differences that exist between the outside and the interior.

Energy Exchanges in Muscle.

In isolated muscle it has long been known that oxygen is necessary for the preservation of the excitable state. A muscle left at rest in oxygenated salt solution maintains its condition for long periods if it be thin enough for the relatively slow process of diffusion to supply it adequately with that gas. A resting muscle uses oxygen continuously at a rate depending on the temperature: at 20° C. this is about 0.7 cubic millimetre per gram per minute: probably this process of oxidation at rest supplies the energy necessary in order to maintain the complex dynamic equilibrium of the living material in a steady state. The known diffusion constant of oxygen through muscle, as found by Krogh, and the rate of its consumption, allow us to calculate that a thin sartorius muscle of a frog can easily remain in a steady state in oxygen just so long as combustible material is available. The isolated muscle at 20° C. uses about its own volume of oxygen per day: and if it contains 1 per cent of glycogen this form of fuel alone should be sufficient, at that rate of oxidation, for some eight days. Dissected aseptically and suspended at rest in a suitable salt solution a frog's sartorius will, in fact, if supplied with oxygen, function for a week or more.

Deprived of oxygen, such a muscle produces lactic acid from its glycogen, the glycogen breaking down in this case about five times as fast as it did in oxygen. If the lactic acid be able to diffuse away, as is the case when the muscle is suspended in oxygen-free salt solution, the muscle lasts for a day or two, responding to a test stimulus at any time within that period: finally, however, its excitability vanishes with the disappearance of its store of carbohydrate. It may remain longer if glucose be included in the salt solution. Apparently, if oxygen be not available, the breakdown of carbohydrate into lactic acid can replace the oxidation of carbohydrate as a source of energy. Presumably, therefore, in the absence of oxygen, the formation of lactic acid is the process which supplies the free energy by which the dynamic equilibrium is maintained, by which, so to speak, the accumulators are kept charged.

The term 'free energy', used in this connexion, should be understood in its strict thermodynamic sense. It is interesting and important, as Burk has recently done, to calculate the free energy of the reaction by which, in living tissue, glycogen is broken down into sodium lactate. We consider the whole process, dissolved glycogen transformed in the buffered alkaline medium of the muscle into dissolved sodium lactate. Owing to the difference in chemical structure between the lactic acid and the glucose molecule, namely, in the ratio of the number of carbon atoms to the number of carbonyl oxygens, there is a considerable amount of free energy available in this breakdown, about 400 calories per gram of glycogen transformed. For this reason, presumably, Nature has selected this particular reaction as the means of providing, in the absence of oxygen, the free energy required, either for doing work, or for maintaining (against diffusion and similar irreversible processes) the osmotic and other differences existing during life at the boundaries and other interfaces of the cell. The free energy of the oxidation of glycogen is of course greater than that of its splitting to lactic acid: it is about 4000 calories per gram. If oxygen be absent a given process requires, let us say, 1 gram of glycogen to be broken down to lactic acid, yielding 400 calories of free energy: the same process, if oxygen be present, requires only one-fifth of a gram of glycogen to be oxidised, yielding 800 calories of free

energy 400 of the latter are wasted, apparently, in the recovery process.

If, as I said, lactic acid is able to diffuse away, the muscle can continue to function until all its carbohydrate store is spent If, however, it be suspended in nitrogen and not in salt solution, its lactic acid cannot escape and the end comes on much earlier At 20° C in nitrogen a muscle produces about four millionths of its weight of lactic acid every minute about 0 3 per cent in 12 hours At this stage the increase in hydrogen ion concentration due to the accumulating acid renders the muscle completely inexcitable : in less than 24 hours it attains the so-called lactic acid maximum and passes into *rigor mortis*

The same processes can be observed to occur more rapidly when activity due to stimulation is substituted for resting survival A muscle subjected to a series of maximal induction shocks in nitrogen fails when it has given some 400 twitches, when its lactic acid concentration has reached about 0 25 per cent. Suspended in oxygen-free salt solution and stimulated with a frequency low enough to allow its lactic acid to escape by diffusion, it can give several times as many twitches (as my friend Kupalov has recently shown), and will continue until practically all its carbohydrate has been broken down , suspended in oxygen, or in oxygenated salt solution, it can give several thousand twitches and maintain its activity until all its carbohydrate is oxidised Moreover, as is now well known, if it be fatigued in nitrogen, and then allowed to recover in oxygen, its lactic acid vanishes and four-fifths of the corresponding amount of glycogen reappears. The free energy required for the reaction

$$\text{Lactate} \longrightarrow \text{glycogen}$$

is provided by the oxidation of a fraction (about one-fifth) of the lactic acid How this synthesis occurs, and what the chemical nature of its mechanism is, are not known but it undoubtedly does occur, and not only in muscle but also in practically every organ and tissue examined

The work of Warburg on the metabolism of tumour and other tissue is a highly important product of these studies originally conducted on muscle and earlier, in another form, by Pasteur on yeast It seems that nearly every kind of animal tissue employs the lactic acid breakdown, when deprived of oxygen, as the source of the free energy required for the maintenance—against irreversible processes —of its steady living state and that certain types of tissue, particularly those found in malignant growths, actually prefer the lactic acid mechanism and may be relatively incapable of employing that of oxidation

There is no reason to believe that when oxygen is present the processes at work are other than the sum, or the resultant, of these two The free energy of the lactic acid breakdown is apparently the source of the mechanical energy liberated by muscle, alike in the presence and in the absence of oxygen In the former case, however, a slow recovery process ensues, in which—perhaps under the action of a galvanic combustion element, as suggested by Straub for the case of the hen's egg—the lactic acid formed in the initial process is re-formed into its precursor glycogen Moreover, the processes of resting survival and of activity are so similar that there appear to be strong grounds for supposing that, at rest also, the primary mechanism in which free energy is liberated (to counteract irreversible processes which lead finally to chaos and death) is that of lactic acid formation from carbohydrate

It is not a wild extrapolation from this, and from the work of Warburg, to conclude that the same is true in all animal tissues The living cell is a complex organised system of enzymes, interfaces, potential and osmotic differences, chemical substances : infinitely improbable in the thermodynamic sense, and yet existing in a steady state so long as free energy is available to maintain the organisation. The free energy of the carbohydrate–lactic acid breakdown is apparently the *sine qua non* of this maintenance, the common factor in the organisation of living animal cells The primary function of oxidation is the reversal of this breakdown

Reversible Inexcitability in Muscle.

All who have worked with isolated muscles have found—alas, too often—that these may 'die' without apparent cause and spoil their experiments They do it more at some seasons than at others, often for weeks on end : some muscles are worse in this respect than others · and if we have not attributed it to the machinations of the devil (physiology leads many of us to a belief in that gentleman) we have been fain to call it 'fatigue', thereby expressing our ignorance of the whole matter If we knew that a muscle survived better in oxygenated salt solution than in oxygen gas, we talked about the removal of 'fatigue products' in the former, even though the muscle—being supplied with oxygen and at rest—was never fatigued at all. It took two chemists, Dulière and Horton, to detect what physiologists should have recognised long ago, that a state of reversible inexcitability sets in spontaneously in isolated dissected muscles. It is true that some years ago, in the biochemical laboratory at Cambridge, it was shown that the legs of frogs, kept

at a low temperature in oxygen, gradually in the course of a week or so lose their irritability, which can be restored by soaking in salt solution. It is not certain, however, that this is the same phenomenon, and in any case Dulière and Horton have demonstrated it in much more striking and—one might almost say—provoking form

A sartorius muscle is dissected with the utmost care from a frog and suspended in moist oxygen, or nitrogen, or air silver or platinum electrodes are brought in contact with it and at intervals its response is tested At first stimulation leads to an active contraction , as time goes on, however, the muscle apparently dies it is not fatigued, it has been quite infrequently stimulated, and in oxygen or air there should not be, and in fact there is not, any accumulation of lactic acid In an hour or two the muscle is apparently dead, it responds not at all to the strongest stimulus, though if it be taken out and tested chemically it is found to show all the chemical characteristics of resting muscle

The phenomenon is not due to oxygen as such, or to the absence of oxygen . it cannot be attributed to surrounding the isolated muscle by a gas, since it happens also in liquid paraffin and mercury. I called it 'reversible' Immerse the muscle, when it has become completely non-excitable, in salt solution, and its excitability returns, rapidly at first, more gradually later, following approximately a course we should expect were the return of excitability due to the outward diffusion of something present in the muscle Any reasonable salt solution will cause a return of the excitability · Ringer's solution, sodium chloride,—anything, in fact, which does not itself lead directly to inexcitability in the muscle

It would be easy, so far, to imagine that some product of activity in muscle, gradually accumulating, produces a toxic effect which leads to the inexcitable state This simple suggestion, however, is not sufficient. If we soak a muscle, for three hours after removal from the animal, in salt solution, and then suspend it in a gas, it will remain excitable indefinitely If we wash it for three hours after it has become inexcitable, its returned excitability will remain indefinitely, that is, until its carbohydrate reserves are used up or bacterial invasion sets in. If, however, we wash it for a shorter time, say for half an hour, after it has become inexcitable, its excitability indeed returns, but when we place it again in a gas, it becomes inexcitable once more Not until the sum of the times of immersion has attained a certain value does the muscle become permanently excitable in the present sense If any product of metabolism has a toxic effect, why should further metabolism after a 3-hour preliminary soaking in Ringer's solution now have no result ? Are we dealing here with the same curious phenomenon as Furusawa found in the case of a crab's nerve ? Moreover, why do the muscles of a frog's leg, allowed to remain *in situ* after the death of the animal and the removal of the skin, retain their excitability for hours, while a companion muscle dissected out and, to all intents and purposes, uninjured, becomes inexcitable in an hour ? The muscle is not dead, for it shows a normal resting metabolism and can be revived by washing with salt solution it may then live for days, which is a sign that any injury due to dissection is of negligible importance Is the effect of a subtle physical nature, due to contact of the living tissue with a medium of unusual dielectric constant ? Or is it to be attributed to the production of some substance, in or between the cells, which can be washed away by contact of the muscle with salt water ? The phenomenon is an easy and dramatic one to witness, once one realises its existence, but a difficult one to explain. The realisation, however, that it occurs has greatly simplified experiments with isolated muscles, for we know now that by a preliminary period of washing we can prevent an occurrence which has spoilt so many experiments

There is one possible explanation. If a Ringer's solution be prepared containing four times the usual concentration of potassium chloride, a muscle immersed in it slowly becomes inexcitable One which has become spontaneously inexcitable by standing in oxygen shows no return of excitability when immersed in this solution. We might have expected a temporary return A muscle consists of fibres and interspaces, mainly fibres In the inside of the fibres there is a very high concentration of potassium, in the interspaces a low one Excitability may depend—among other things—upon a normal concentration ratio of potassium across the boundary of the cell Experiments have shown that when muscles are perfused, potassium tends to leak into the perfusing fluid If it leaked into the interspaces between the fibres—not much would be required—it might gradually produce the same state of inexcitability as we can cause by the artificial application of a high potassium concentration The chief difficulty in this explanation, which has much else to commend it, is that one cannot see why a few hours' immersion in salt solution should prevent any further egress of potassium In any case it seems that the phenomenon is of a physical or of a physico-chemical nature, and has no connexion with the oxidative mechanism of the cell.

Anaerobic Disintegration in Muscle

I come lastly to the most difficult problem of all the cause of a phenomenon which I discovered in 1927 and about which I speculated last spring, perhaps rather rashly, in the *Proceedings of the Royal Society* I say rashly, partly because my paper was the innocent cause of much excitement in the autumn, when the public Press discussed—in the 'silly season'—the 'mystery of life' partly because the explanation I originally gave may not be sufficient The facts, however, seem certain, and are these By improvements in technique, the rate of resting heat-production of a muscle can be measured, in oxygen or in nitrogen The muscle lies in nitrogen upon the warm junctions of a thermopile, in a thermostat maintained at a constant temperature The rate of the resting heat-production at 18° C is (say) 60 gm cm. per gram per minute about $1\frac{1}{2}$ thousandths of a calorie The muscle has previously been washed for some time in salt solution, so that it does not now become spontaneously inexcitable in the manner described by Dulière and Horton It is stimulated and gives a series of twitches the heat due to activity is registered by the galvanometer attached to the thermopile stimulation ends the galvanometer returns we should expect it to return, gradually, of course, to its original position, the muscle to revert to its original heat-rate Nothing of the kind. I may illustrate what happens by a typical experiment

Time A.M or P M.	11 56	11 59	12.1	12 2	12 $3\frac{1}{2}$	12 5	12 6
Galvanometer deflection mm.	22	$23\frac{1}{2}$	$23\frac{1}{2}$	$22\frac{1}{2}$	$22\frac{1}{2}$	24	23

The muscle was then stimulated by single shocks to fatigue the galvanometer deflected, and, when the stimulation ended, returned to rest once more

Time P M.	12 20	12 23	12 25
Galvanometer deflection . mm	130	130	130

The resting heat-rate in this case has been increased between five and six times.

The phenomenon has never failed to appear, and it occurs always in the same quantitative form The quotient

$$\frac{\text{increment in heat-rate per minute}}{\text{total heat by stimulation}}$$

is always (in the frog's sartorius at 17° C.) of the order of 0·0075 The high heat-rate induced by stimulation is permanent so long as the muscle remains in nitrogen It may attain 800 gm cm. per gram per minute after severe fatigue—more than 1 calorie per gram per hour It may remain at this level, so long as the muscle is kept in nitrogen, for 24 or even 48 hours, in which time the total heat liberated may be many times as great as can possibly be accounted for by the breakdown of *all* the available carbohydrate into lactic acid Since, apart from carbohydrate, there is very little except the actual protein of the muscle which we can imagine to break down with such an evolution of heat, we are forced to conclude that the process of anaerobic activity (or its products) has somehow induced the degradation of the muscle protoplasm itself to bodies containing less total energy.

If, when the muscle has been fatigued in nitrogen, and its resting heat-rate is high, we admit oxygen, a recovery process sets in as usual, with a considerable evolution of heat The lactic acid is removed and the muscle is restored to its previous resting condition This occupies about an hour. If, now, we replace the oxygen by a stream of pure nitrogen, within half an hour diffusion on one hand, and the resting metabolism of the muscle on the other, have removed the last traces of oxygen from the interior of the muscle substance, and the resting heat-rate in nitrogen can again be measured. Instead of the high value found after stimulation, we now observe a low value of the same order of size as before it. The breakdown processes produced by anaerobic activity have been cut short and the muscle has regained its previous steady state The same treatment can then be applied once more If the muscle be stimulated to fatigue again its resting heat-rate rises · if oxygen be again admitted recovery ensues, and finally a low value of the resting heat-rate appears as before

There seem to be two alternatives either (1) the provision of energy by oxidation has restored to their normal state the membranes, interfaces, or agents, which in ordinary life hold apart the unstable reacting substances present in the living cell, which prevent—as I said in my paper—the organised system of the living cell from becoming a biochemical chaos , or (2) in the presence of oxygen some substances have been removed, perhaps by simple oxidation, perhaps by restoration to a precursor, which, if they be allowed to remain, assist as catalysts, or in some other capacity, in the anaerobic disintegration of the living material One thing seems certain—the high heat-rate *is* a sign of some kind of irreversible breakdown or disintegration : if—as Kupalov has shown—it be allowed to continue for a few hours, no subsequent restoration of the muscle to its normal excitability is possible, either in oxygen or in oxygenated salt solution.

The phenomena in question are so curious, and the effects so relatively large and so easily demon-

strated, that they demand an explanation. They have been tested by every means available and have withstood the attack Were they due to a change in the hydrogen ion concentration caused by the liberation of lactic acid ? A resting muscle was immersed in pure carbon dioxide and its heat-rate remained practically unaltered . the carbon dioxide must have made it as acid as extreme fatigue Were they due to a technical error of some kind ? To a reaction of some fatigue product with the metals of the thermopile ? The thermopile was insulated with baked 'Elo' (an artificial resin), shellac, and paraffin wax : on top of these a piece of tin-foil and over this a further layer of wax The phenomenon appeared quantitatively as before It is inconceivable that breakdown products of muscular activity can penetrate wax, tin-foil, wax, shellac, and 'Elo', one on top of the other Was it due to injury in dissection ? It was found unaltered in a frog's gastrocnemius, which can be prepared with a minimum of injury. The temperature was lowered to 0° C. The high heat-rate existing in a fatigued muscle diminished to one-sixth, which is what we should expect were it due to a chemical process occurring continuously, not at all what we should look for were a technical physical error the basis of the phenomenon

I was inclined, when I first described the phenomenon, to the first of the two alternatives just mentioned, to the belief that oxygen restores the normal interfaces, or conditions, which prevent the organised system from becoming a biochemical chaos During the last few months, however, I have come across another effect which inclines me a little to the second alternative—perhaps both are correct The experiment is a simple one and the result quite certain : it ought to have been made long ago . but one only thinks of these things slowly If a muscle showing a very high resting heat-rate induced by anaerobic stimulation be immersed for an hour or two in *oxygen-free* salt solution, its heat-rate returns to its original low level . the muscle need not even be alive it may have been 'electrocuted' by excessive stimulation, it may have been irreversibly damaged by too long a maintenance of its high heat-rate in nitrogen. Yet, under the influence of the washing, in a time which suggests diffusion outwards of some catalysing agent, the breakdown evidenced by the previous high heat-rate is completely—or almost completely—stopped Clearly, oxygen as such is not necessary for a reversal of the effect. Perhaps if lactic acid be not already present in excessive amount, the lactic acid breakdown can take the place of oxidation in the maintenance of the normal internal architecture of the cell . perhaps, however, *something* is set free in the absence of oxygen, which induces—or helps to induce—the irreversible breakdown of the muscle protoplasm with a liberation of energy a something which can be dialysed away by immersion of the muscle in salt water.

It is well known that, in man, too prolonged exposure to anoxæmia may produce harmful effects lasting for a long time or even permanently As Haldane writes "A short exposure even with loss of consciousness produces no serious after-symptoms . but occasionally a man's behaviour is very abnormal for a few minutes after recovery " "With severe and prolonged exposure to want of oxygen the nervous after-symptoms are of an extremely formidable nature and often end in death " "The symptoms are evidently due in the main to widespread injury to the nerve cells during the exposure " "The heart may also suffer in prolonged exposure to want of oxygen The after-symptoms may be mainly cardiac , it may be a considerable time before the heart fully recovers " "Probably every other organ and tissue in the body feels the after-effects of severe exposure to want of oxygen The patient often enough dies of pneumonia Acute nephritis and gangrene of extremities have been noted " And so on May we not be witnessing here in man the after-effects of the same partial disintegration of the living protoplasm as can so easily be demonstrated in anoxæmia in the isolated muscle ?

In Warburg's work we find further evidence of a harmful effect of oxygen lack An embryo of a chick is kept for some hours in salt solution saturated with nitrogen oxygen is then introduced In the normal embryo there is practically no lactic acid formation if sufficient oxygen be present the free energy required for continued existence is supplied by oxidation In the embryo which has been subjected to a period of anoxæmia, however, the capacity for oxidation is found to be diminished and a large part of the energy it requires must now be derived from the lactic acid breakdown By anoxæmia, in fact, the normal embryo has been reduced to a state in which its metabolism is similar to that which Warburg has found to characterise tumour tissue Can it be, as Warburg's work suggests, that oxygen-lack, working upon the normal architecture and machinery of the cell, leaves behind a type of mechanism analogous to that of tumour ? Dare we see in the disintegrative process set up by anaerobic activity in the isolated muscle cell an exaggerated case of the harmful effect produced in man by prolonged and severe anoxæmia, or in the chicken embryo by oxygen want ? It is dangerous to speculate too far, but it is foolish not to speculate at all.

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learn to look at architecture as it might appear to an observer from another planet, to whom its human origin was unknown, and on the whole this detachment is more nearly attained by the landscape painter than by the historian or even, perhaps, the architect himself

The old towns of the Riviera crowning the foothills of the Alpes Maritimes, or capping promontories which project against the blue Mediterranean, provide as usual the subject for one kind of culmination of natural in architectural form Of the purely natural landscape of this delightful coast there are as usual several studies, of which Mr H Van der Weyden's The Lone Pine of La Mortola (208) is the most considerable , but it is to be regretted that the landscape of the tropics should be almost unrepresented in the Exhibition The gamut of the emotions evoked by the world's scenery remains incomplete so long as the tropics are passed over, and the traveller longs to see at least something which will recall the coast with fringe of waving palms and the gleam of green translucent water within the coral reef, with its line of foaming breakers and deep blue sea beyond

Among the artists who are enterprising in their research for natural effects Mr W. L Wyllie is certainly to be reckoned, and in Fifty North and Forty West (207) he gives us the impression of an occurrence which is never seen without a thrill of excitement, the sudden breaking away of the whole summit of a great dome-shaped wave in the foaming cap which sailors call a ' cauliflower sea ', which, launched bodily forward, is here seen rolling towards the observer

Such were the aspects of Nature, or the emotions aroused by aspects of Nature, which I found observed and recorded by our fellow-students, the landscape painters in this year's Exhibition of the Royal Academy

News and Views.

In his Ludwig Mond lecture, delivered recently at the University of Manchester, the main part of which appears as a supplement to this issue of Nature, Prof. A V. Hill refers to the value of experiments carried out on isolated animal tissues for the elucidation of the phenomena of life, and illustrates his thesis with descriptions of some recent work performed on the isolated nerve and muscle of cold-blooded animals Both tissues consume oxygen not only as a result of activity but also whilst at rest it appears that not only is the production of energy in the form of a nerve impulse or a muscular contraction accompanied, or followed by, the consumption of oxygen, but also oxygen is required for the process of remaining alive and irritable, of being ready to respond to a stimulus. The isolated muscle uses the absorbed oxygen to oxidise glycogen , in the absence of oxygen, lactic acid is formed from the glycogen, which breaks down much more rapidly than in the presence of oxygen, and the free energy of this breakdown suffices to maintain irritability in the muscle for a short time, provided that the lactic acid is removed by immersing the muscle in saline. In the presence of oxygen a portion of the acid is completely oxidised, but the remainder is resynthesised to glycogen, so that in the presence of oxygen the muscle lives much longer than in its absence.

The next step in the chain of evidence given by Prof Hill is the result of studies of a muscle stimulated in nitrogen to fatigue. The heat production at rest after the stimulation is much greater than before, and may in time exceed the amount that can be obtained by the breakdown of all the carbohydrate into lactic acid, indicating that the muscle protein is also breaking down The resting heat production can be reduced to its low pre-stimulation level by immersing the muscle in oxygen-free saline or by supplying it with oxygen The exposure to nitrogen, then, appears to have initiated a degradation of the muscle protoplasm which can be stopped by again admitting oxygen, or by washing away some substance which may be supposed to aid the protoplasmic breakdown In any event, the deleterious effects of asphyxiation appear to be due to disintegration of the cells of the tissue themselves, and, conversely, oxygen is necessary for the maintenance of cell structure. Put in other words, Prof. Hill argues that the living cell may be considered to be in a state of dynamic, as opposed to static, equilibrium, and therefore to require a supply of oxygen for the maintenance of its very structure.

On Monday next, May 13, Messrs. Sotheby and Co. will offer for sale a collection of letters (1743–1820) from and to Sir Joseph Banks, president of the Royal Society. They are being sold by a collateral descendant of Dorothea Lady Banks, wife of Sir Joseph Banks The series includes botanical and horticultural letters and papers of Australian interest—communications to Banks from the early governors of New South Wales—also letters of Matthew Flinders, George Bass, and Bligh. It would seem improbable that any have been published ; no indication, however, is supplied as to this The correspondence is suitably secured in handsomely bound folio albums, each having a list of contents, though unfortunately no numbers are given to accord with the sequence of letters , thus reference is tedious.

Among miscellaneous matter (Lot 7) we notice a letter of Thomas Young, in a fine script, addressed to Count Rumford at the Royal Institution and dated July 9, 1801. It refers to his appointment to the professorship of natural philosophy. "As to the journals", he says, "I should not much object to engage that a sheet or more should be read for publication every week , but I conceive that it would give them additional importance if it were left to the discretion of the professor, with the approbation of the committee, and with proper notice, to publish a number at the end of a fortnight instead of a week, whenever there might appear to be a real deficiency of

matter to fill it. As I think I should want little or no assistance either in translating or transcribing, except what Mr Davy might have the goodness to give me, I hope when you have reconsidered what I have stated you will not much differ from me in opinion."

AT Oxford, on May 4, under the auspices of the Society of Friends of the Old Ashmolean, a public lecture was delivered by Prof. D'Arcy Thompson on "The Hellenic Element in the Development of Science". It was shown that Aristotle's doctrine of excess and defect, applied by him in the region of biology as in that of ethics, was in accordance with conceptions of Greek mathematicians in regard to the theory of numbers, especially as developed in later times by Theon of Smyrna in the series known as the 'indeterminate' or 'boundless' dyad. The geometrical aspect of number was always kept in view by the Greeks; Euclid's treatment of the square of the hypotenuse exemplified this, and his whole system culminated in the dodecahedron with its pentagonal surfaces Much of the fabric of modern science has its foundation in the mathematical conceptions amplified and illuminated by the genius of the Greeks, but shared with them by other peoples, as by those of Egypt and Chaldea. The lecture, which was largely attended, was followed by a meeting at which various donations to the Lewis Evans collection were announced, and means were considered for increasing the membership of the above-mentioned Society

ON Saturday, May 11, Lord Birkenhead is to unveil stained-glass armorial windows given for the embellishment of the staircase of the Old Ashmolean Building, Oxford. Two armorial windows are being added to those already in the Museum to commemorate the foundation gift of historic scientific instruments by Dr Lewis Evans, and in gratitude to four of the great City Companies which by timely benefactions made it possible for the University to install the Evans collection in the Old Ashmolean, and thus to fulfil the condition on which it was offered to Oxford. The Evans window is presented by certain members of the Society of Friends of the Old Ashmolean, chief among whom was the late Lady Osler. It is inscribed. LUDOVICUS EVANS, D SC., QUI MUSEUM ASHMOLEANUM DENUO LOCUPLETAVIT INSTRUMENTIS NATURALIS SCIENTIAE COLLATIS HIC COMMEMORATUR MCMXXV. The second window, given by Sir Dugald Clerk, bears the arms of the Companies of the Goldsmiths, Ironmongers, Clothworkers, and Fishmongers. It is a delightful composition, and a reminder of their many services on behalf of education. The inscription runs. MUSEI ARMARIA INSTRUXIT ET ARCAM DITAVIT GILDARUM LONDINIENSIUM LIBERALITAS QUARUM INSIGNIA DEPINGENDA CURAVIT DUGALDUS CLERK MCMXXIX. The earlier windows commemorate Elias Ashmole, the first founder of the Museum in the seventeenth century, and his friends, John Tradescant the younger, Dr. Plot, and Sir Christopher Wren. The new windows which Lord Birkenhead is to unveil relate to the re-founding of the old Museum in the twentieth century after a lapse of thirty-five years, during which it had been allowed to fall into a neglected state.

AMONG the portraits in the exhibition now open at the Royal Academy, that of Sir Ray Lankester by Sir William Orpen is acknowledged to be the outstanding picture of the year The fundamental note of the picture is that of declining years, yet the harmonies give it wonderful tone. There is still an inquiring look in the face, with its fine forehead and the clear, steady eyes which always seem to mirror thought and observation, while the beautifully formed hands are given their full value in an easy attitude which seems to signify rest after labour Another very successful portrait is that of Prof J. Millar Thomson, emeritus professor of chemistry, King's College, London, by Mr P A Hay. Mr Richard Jack exhibits a fine picture of Lord Moynihan, president of the Royal College of Surgeons, and other portraits of people well known in scientific circles are those of Mr E F. C. Trench, past president of the Institution of Civil Engineers, by Mr George Harcourt; Mr. W. Tapper, president of the Royal Institute of British Architects, by Sir William Orpen; Mr. J. L. S Hatton, principal of the East London College, by Mr Augustus E. John; Prof Priestley Smith, emeritus professor of ophthalmology, University of Birmingham, by Mr. Harold Speed, Sir Hugo Hirst, chairman and managing director of the General Electric Co., Ltd, by Mr. Richard Jack, and Mr. A S Ramsey, president of Magdalene College, Cambridge, by Mr Francis Dodd. There is also a bust in bronze of Col R E Crompton, by Mr. George H Paulin, and a miniature of Prof. J. P Hill, by Elizabeth A Steele

THE fourth Huxley Memorial Lecture of the Royal College of Science was delivered by Prof F O Bower, at the Imperial College of Science and Technology, on Friday, May 3, the title being "The Origin of a Land Flora, 1908–1929". Prof Bower began by referring to his book "The Origin of a Land Flora", published in 1908 He summarised the theory of 'interpolation' there put forward to account for the origin and progression of the spore-bearing plants, the dominance of which is so striking in all land plants from the ferns upwards. He then indicated the more important modifications in the view expressed twenty-one years ago which have resulted from advances in botanical knowledge. The chief of these concern, first, the expansion of our knowledge of alternation of generations in the brown and green algæ and the significance of the cytological distinctions between the two generations in these plants Secondly, the outlook has been changed by the increase in the knowledge of the very simply organised plants now known to have existed in early Devonian times; thirdly, a study of the embryology of the Psilotaceæ has shown that this group now stands nearest to these ancient fossils.

GIVING these new facts and others their full value, Prof. Bower holds that his position as stated in 1908 needs "neither reversal nor obliteration but only modification". He suggested that the remote ancestors of the Archegoniatæ were of the same general type as the Green Algæ, but in these ancestors the act of meiosis was deferred, and a diploid phase

interpolated which was structurally suited to subaerial conditions and bore numerous spores. These plants would thus at one stroke achieve three biological advantages of prime importance: (1) a multiplication of possible combinations of hereditary characters (as suggested by Svedelius), (2) an opportunity of securing a wide spread on dry land by the dissemination of spores; and (3) relief from dependence on repeated syngamy by numerical increase on land, where the necessary medium of external liquid water is not always available. In conclusion, Prof. Bower pointed out that while the gap between the Algæ and the Archegoniatæ is still open, and indeed remains as in 1908, yet the evolution of the constituent parts of the land-living sporophyte can now be traced with the aid of the early Devonian plants.

ACCORDING to a recent *Daily Science News Bulletin* issued by Science Service, Washington, D.C., a notable invention was announced to the National Academy of Sciences on April 19 by General G. O. Squier, the inventor of 'wired wireless'. The principle of wired wireless is the same as that used in sending telegraph or telephone messages over lines carrying signals of different frequency or over power lines. The new method, which is called the 'monophone', is the perfection of a form of radio transmitted partly by telephone wires. In America the ether is inconveniently crowded with messages of all kinds. It is now proposed to make the ordinary telephone wires carry some of these so as to relieve the congestion. In particular, without interfering with the present point-to-point service of the broadcasting and without change of equipment, the telephone wires can be made to work sixteen hours a day, bringing the broadcasting programmes to the householder. It is suggested that this 'line radio' could be made to provide a method of financial support to the broadcasting companies, thus eliminating the necessity of broadcasting advertisements both directly and indirectly. The small power used in this system is also claimed as a further advantage. The power taken by a small incandescent lamp would be sufficient to supply five thousand telephones. When operating the telephone-connected set, no tuning would be necessary. To get a new programme all that is necessary is to turn a switch. Fading and the various kinds of interference which prevent good broadcast reception would be eliminated. There would be no difficulty in receiving sound-motion pictures and television by this method. It could be usefully employed for educational purposes.

ANOTHER development in broadcasting was described by Prof. A. L. Foley, of Indiana University, in a paper read on April 23 to the National Academy of Sciences, on a new type of microphone for use by broadcasters and public speakers. It is still in the experimental stage, but as the principle is novel it is considered to be very promising. It contains no moving diaphragm. A usual type of microphone (or 'mike' as it is frequently called in America) is the condenser microphone. A thin diaphragm of metal is hung in front of a metal plate with an air space between them. Both have electrical charges, and as the diaphragm is pushed or pulled by the sound waves the electrical charges fluctuate in value and electrical currents flow. Some of the energy is radiated into space and picked up by the receiver's set. The difficulty with any type of diaphragm is that it has free vibration periods of its own which it tends to assume, thus distorting the forced vibrations due to the sound waves. In Prof. Foley's microphone there are only two solid metal plates with an air space between them. The sound waves of the speaker's voice directed between the plates cause alternate condensations and rarefactions of the air. As the air is acting as the dielectric of the condenser formed by the plates, the rapid changes in its density cause alternating currents in the plates, which are used to radiate energy into the ether. Prof. Foley says that the new device is in process of development and will not be on the market for some time.

THERE is always interesting matter in the Annual Report of the Zoological Society of London, the centenary celebrations of which were referred to in our issue of May 4. The outstanding feature of this year's report is the remarkable record diagrammatically presented in its "Century Chart of Progress". On the whole, the chart shows a steady record of progress, apart from a slack period which began in 1839 and continued for about thirty years. But the extraordinary rise in the numbers of members and of visitors to the Zoological Gardens in Regent's Park, and in income, which commenced in 1910 and has carried the Society from height to height in almost unbroken leaps, is witness to the success of the policy of Dr. Chalmers Mitchell and the Council, and perhaps also to an increasing love of entertainment which has seized the people of Great Britain. There has been a certain increase in the numbers of deaths, especially amongst mammals and birds, but this is attributed to the increased size of the collection, and the installation of electric heating and lighting into more of the houses in the Gardens shows that every effort is being made to ameliorate the living conditions. No indication is given of the effect upon general health and mortality of the electric systems already installed. Such information, based upon the definite records of the pathologist, would afford an invaluable guide to other zoological gardens at home and abroad which, on account of the great cost, hesitate to install electric fittings until their value has been clearly proved.

THE second number of the *Realist* continues some of the subjects begun in the first and gives a clearer idea of the general idea which the promoters have in mind. It is to be a journal of scientific humanism, and this must mean treating of matters of living human interest in the light of scientific research. It does not at present offer any review of scientific works or attempt to summarise the recent additions to our knowledge, but matters of current moment and discussion are taken up and suggestions made as to the lines of future development. The emphasis, in fact, is rather strongly laid in these opening numbers on the present and, still more, the future. The first article in the May issue, by G. E. G. Catlin, deals in this spirit with the 'Next Step for Democracy'

The outstanding point in the recent American presidential election is well taken. Both candidates were in the true sense realists and represented a great advance in the political sense of the democracy which adopted them as its champions. It is clear that in the modern conditions of extreme complexity and world-wide extent of industrial and social relations, real expertness is needed in those actually in power. It is also apparent that control of the industrial conditions and relations of one State and another has already become more important than the merely political relations of the old governments and diplomacy. This involves more scientific expertness on the part of the governors and a better appreciation of such expertness on the part of the governed.

Most of the other articles in the *Realist* for May strike a similar keynote to that sounded by Prof. Catlin. That on the "Crisis in Psychical Research", by Mr. E J. Dingwall, will interest a good many people by its suggestion for a new thoroughly sound and independent investigation of recent phenomena of a spiritualistic kind The point is made that the Society for Psychical Research, which was founded to do this very thing, has lost its standing as a scientific body just at the time when the phenomena to be investigated have become more numerous. Dr. Charles S. Myers gives an account of the work and the results of the Institute of Industrial Psychology. Cases are quoted in which not only greater industrial efficiency has been secured and sickness among employés has been reduced, but also the earnings of the workers have been increased Mr. H Martin Leake has a somewhat similar plea for the rationalisation of British agriculture. Dr. Norman Haire concludes his account of the recent experiments in rejuvenation, mainly of Voronoff and Steinach. He sounds a fairly hopeful note while admitting that it is at present impossible to decide whether any of these procedures actually prolong life in a human being. Dr. A. P. Laurie has a short but very interesting and convincing defence of the scientific analysis of the materials and methods of the old masters. Much of this has appeared in letters to the *Times* and it is useful to have it collected. The editor, Major A. G Church, has an equally persuasive article on the need of applying scientific methods to the development of our imperial possessions This is imposed upon us, both by our monopoly of so much of the world's richest soil and the 'sacred trust' which we have professed to the world for the well-being and development of the backward races

The curators of the University of Edinburgh unanimously agreed to offer the principalship—which will become vacant on Sept 30 by the resignation of Sir Alfred Ewing—to Sir Thomas Holland, Rector of the Imperial College of Science, London, who has accepted the appointment. Sir Thomas is at present in South America, and the negotiations have been completed by cable. He is to be president of the British Association during the forthcoming meeting in South Africa, and it is understood he will not arrive in Edinburgh until about the middle of October. He will take to his new office a wide experience—academic and administrative—and extensive first-hand knowledge of conditions in the Dominions and in India, a matter of great importance to the University of Edinburgh, which has more students from overseas than any other university in Great Britain.

At the meeting on May 2 of the Linnean Society of London the following honorary members were elected Dr Theodor Mortensen, superintendent, Zoological Museum, University of Copenhagen, distinguished for his researches on Echinodermata and other marine organisms , Prof Carl Hansen Ostenfeld, professor of botany and director of gardens and museum, Copenhagen, distinguished for his researches on the taxonomy and distribution of arctic plants, and also on cytology, heredity, and phytoplankton , Prof Bohumil Němec, professor of plant anatomy and physiology, Charles University, Prague, distinguished for his researches in cytology, physiology and anatomy of higher plants, and in mycology and bacteriology. The presidential address of the Society will be delivered at the anniversary meeting on May 24, when the Gold Medal will be presented to Prof Hugo de Vries, who, unfortunately, on account of ill-health, will not be able to be present.

The fortieth anniversary of the completion of the Eiffel Tower in Paris was celebrated on May 2 by the unveiling of a bust of Gustave Eiffel at the base of the tower The ceremony was performed by M G. Martin, Secretary for Posts and Telegraphs, who paid a tribute to the great engineer. Eiffel was born at Dijon on Dec 15, 1832, and died in Paris on Dec. 28, 1923 He was a student of the École Centrale des Arts et Métiers ; he obtained a wide experience of engineering construction, and by 1887, when he began the Tower, had built iron and steel bridges, etc , of more than 100,000 tons total weight. The Tower, which is 984 feet high, is still the highest structure in the world. It is a resort of sightseers, but it is also used as a wireless and meteorological station. Nearly 14,000,000 persons have ascended the Tower since its construction Eiffel served as president of the French Society of Civil Engineers and was also an honorary life member of the British Institution of Mechanical Engineers

The Ministry of Health has issued a statement respecting the present situation in regard to smallpox. Smallpox of a mild type has been prevalent in England and Wales during the last few years, and in 1928 there were 12,420 cases with 53 deaths The distribution of the disease has been relatively wide, but it has been kept under control or stamped out in all of the 35 or 40 counties in which it has appeared, except in some five to ten districts where it has obtained a greater hold, owing in particular to neglect of vaccination. In the Administrative County of London, with a population of 4½ millions, only 167 cases have occurred this year. Some uneasiness has been occasioned by cases derived from the s s *Tuscania.* This vessel arrived from Bombay at Marseilles on Mar. 27 with passengers and crew numbering 1589, afterwards proceeding to Liverpool and Glasgow. In all, 45 persons from the *Tuscania* have been notified as suffering from smallpox, of whom 7 have died,

but there is reason to think that this epidemic is now at an end, and as a result of the rigorous measures taken, English ports have been kept free

THE Yorkshire Naturalists' Union, founded in the sixties of last century, is one of the oldest, as it is one of the most flourishing of the amalgamations of natural history societies in Great Britain The Annual Report for 1928 states that the affiliation includes thirty-eight local societies, and the summaries of work accomplished by the various sections of the Union show how active is the interest taken in the fauna, flora, and geology of the county. The official organ of the Union is *The Naturalist*, a magazine the usefulness of which as a medium for the publication of natural history in all its branches is emphasised by the absence of an all-England magazine of the same kind. It is a remarkable fact that, since *The Zoologist* died, a Nature-loving country like England should possess no periodical dealing with general natural history on the lines followed by that much-lamented journal.

THE Government Museum at Madras, under the superintendence of Dr. F. H Gravely, and, during his absence in Europe in 1927, of Prof. E Barnes, continues to make good progress. Like other progressive museums, it finds that detailed specialist collections are unsuitable for exhibition, and accordingly the Bruce Foote collection of prehistoric implements has been stored for reference, and the valuable exhibition space which it occupied has been given over to a much-needed expansion of the ethnological collection. The Buddhist sculptures have been re-arranged, and a description of part of this exhibit is in the press, and various improvements have been made in the zoological and the coin collections. Appendices to the Administration Report for 1927–28 show that the Museum receives a very small proportion of its material as gifts from the public, and that a surprising number of coins and of copper statues of saints and kings turned up as treasure-trove in the villages of the Presidency.

A SOMEWHAT alarmist article on "Fundamentalism in England", by Maynard Shipley, appears in the March number of *Evolution* Among other statements, it alleges that "much anti-scientific propaganda is being 'put over' in the smaller provincial towns and vast districts of Wales, Ireland, and Scotland, where people still believe in witchcraft, as firmly as our 'Pennsylvania Dutch' towns where no hint of modern scientific thought has so far penetrated." So far as our experience goes, Mr. Shipley's statement, as it refers to Scotland, at any rate, is as shaky as his composition. We have never denied that there is a strong undercurrent of dislike to the theory of human evolution in the British Isles, but it is the 'die-hard' resistance of conservatives who do no more than wish their old-fashioned beliefs to be left alone. It certainly does not express itself in active and fussy propaganda, and much of it will die with its generation. As for witchcraft in Scotland, the most we can say is that a canny Scot may occasionally believe in luck, but even evolutionists of the highest standing have been known to risk their chances at the casinos of Europe.

SOME four or five years ago Dr Percy R. Lowe, of the British Museum (Natural History), discussed with the eminent French ornithologist, M. Jean Delacour, plans for a joint Franco-British Expedition to Madagascar to collect specimens of both living and extinct animals which might possibly supply further clues to the origin of the fauna of this, one of the most interesting islands in the world What was most desired was the discovery of more remains of the extinct ostrich-like fossil known as *Mullerornis*, which may throw light on the past history of all struthions, or ostrich-like birds, and incidentally perhaps of the island itself. Another most welcome discovery would be a complete skeleton of the giant flightless bird *Æpyornis maximus*, which stood at least ten feet high Funds for such an expedition have now been provided by Mr. Arthur Vernay, and the Trustees of the British Museum have loaned the services of a palæontologist, Dr Errol I. White, who is due to arrive at Madagascar towards the end of May. At the last moment the Expedition has been joined by a party of American scientific workers It is now, therefore, representative of France, Great Britain, and the United States of America.

THE Royal Horticultural Society is issuing invitations to the International Congress which the Society is arranging to be held in London on August 7–15, 1930, that is, immediately before the International Botanical Congress meets at Cambridge. A representative executive committee has been appointed by the Society, with Lieut.-Col. Durham, the secretary of the Society, as secretary, to whom the subscription for membership, one pound, should be paid. The programme will include lectures and excursions, and a flower show on the last two days. The main subject for discussion will be "Propagation: vegetative and seminal", for which communications are invited and in which eminent British and Overseas authorities have already signified their intention of taking part. There will also be other sections, and suggestions for papers for consideration are invited. The six committees appointed at the Vienna Congress in 1927 will present their reports. These include a Committee on Nomenclature, the report of which will be awaited with special interest in view of the lack of uniformity in the use of plant-names, especially of varieties and hybrids, which exists at present among horticulturists Communications by means of papers, or participation in the general discussion, will be permissible in English, French, and German. All correspondence should be addressed to the secretary of the Royal Horticultural Society, London, S.W.1.

THE first conversazione this year of the Royal Society will be held at the Society's rooms at Burlington House, W.1, on Wednesday next, May 15.

UNDER the Order in Council dated Feb. 6, 1928, the Lord President of the Council has appointed Sir James Alfred Ewing to be a member of the Advisory Council to the Committee of the Privy Council for

Scientific and Industrial Research, to fill a vacancy occasioned by the death of Mr Robert Whyte Reid.

SIR JAMES IRVINE, Principal of the University of St. Andrews, has been awarded the Elliott Cresson Gold Medal of the Franklin Institute of the State of Pennsylvania "for his brilliant research on Carbohydrate Chemistry." The Medal will be presented on May 25, and will be accepted on behalf of Sir James Irvine by Sir Esmé Howard, British Ambassador to the United States.

AT the annual general meeting of the Society of Glass Technology, held in Sheffield on April 17, Mr. Herbert Webb, of Stourbridge, was elected president in succession to Mr. Walter Butterworth, Sen. The following other officers were elected :—*Vice-Presidents*. Mr. E. A. Coad-Pryor, Dr C. J Peddle, *General Treasurer* Mr Joseph Connolly; *American Treasurer:* Mr. F. C Flint, *Hon Secretary:* Prof. W. E. S. Turner.

THE council of the Institution of Civil Engineers has recently made the following awards in respect of papers read and discussed at the ordinary meetings during the session 1928–29: A Telford Gold Medal and a Telford Premium to Mr Conrad Gribble (London); a George Stephenson Gold Medal to Mr Harry Hall (London) Telford Premiums to Messrs H. N. Colam (London), F W A Handman (London); T. P. M. Somers (Glasgow), H. V C Johnstone (Sudan), and jointly to J H. Hyde (Twickenham) and H. R Lintern (Teddington).

THE disastrous earthquake which occurred in Khorasan, Persia, on May 1, was recorded as a well-marked disturbance at Kew Observatory The preliminary tremors reached the Observatory at 15 h. 45 m 28 s. G.M T., and the records indicate that the epicentre was near lat. 35° N., long. 54° E The disturbance lasted about three hours, and the maximum displacement of the earth at Kew was nearly half a millimetre It is reported that a large area has been devastated and that great loss of life has occurred.

IT is announced in *Science* that the committee of the Academy of Natural Sciences of Philadelphia appointed to select a recipient for the Hayden Memorial Geological Award for 1929 has nominated Dr. Charles Schuchert, professor emeritus of palæontology in Yale University, for the award, in recognition of his distinguished work in invertebrate palæontology, palæogeography, historical geology, and the migration of faunas. The Hayden Award was founded in 1888 by Mrs. Emma W Hayden as a memorial to her husband, Dr. Ferdinand V. Hayden, director of the U.S. Geological and Geographical Survey in the early days of that organisation. It consisted at first of a bronze medal with an honorarium in cash, but it now consists simply of a gold medal, and is given for pre-eminent research in geology, palæontology, or in related sciences.

HIS Majesty the King has approved the award of the Royal Medals of the Royal Geographical Society as follows · Founder's Medal to Mr. Francis Rennell Rodd for his journeys in Air and his studies of the Tuareg people, Patron's Medal to Mr C. H. Karius, assistant resident magistrate, Papua, for his crossing from the Fly River to the Sepik. The Council has made the following awards: Murchison Grant to Mr. C S Elton for his three seasons' study of the distribution of life in Spitsbergen; Back Grant to Mr C. P Visser for his exploration of the Hunza-Karakoram glaciers; Cuthbert Peek Grant to Lieut Donald Cameron for his journey across the Sahara from Nigeria to Algiers, and Gill Memorial to Mr. George Dyott for his recent expedition in search of Colonel Fawcett

WITH reference to the note in NATURE of April 27, p. 655, on the Huygens' object glasses presented to the Royal Society, it has been pointed out to us that Dr. R T. Gunther photographed the signatures "Constantine H", scratched on all three object glasses with their focal lengths, and published them in "Early Science in Oxford", vol. 2, p. 300, in 1923. The photographs show the bubbles in the glass of the lenses very clearly.

THE palæontological collections at Upsala have increased so enormously of recent years, thanks mainly to the receipt of the vertebrate material from China so thoroughly described by Prof. C. Wiman and his pupils, that it was necessary to store them in about half a dozen different buildings. It is good news that the Swedish Riksdag has voted the sum of 791,000 kroner (about £44,000) for a new palæontological institute, in which research and teaching will be more conveniently carried on. Building is to begin in the autumn

WE have received the Annual Report of the Calcutta School of Tropical Medicine, Institute of Hygiene, and the Carmichael Hospital for Tropical Diseases, 1928. Administrative matters are very briefly dealt with, and the bulk of the publication consists of reports of the various departments with summaries of the research work carried out, much of which is of considerable value and importance.

THE Report of the Director-General of Public Health, New South Wales, for the year 1927 has been recently issued. In addition to statistical details, reports of scientific investigations are included. As in former years, a large number of rats were examined for plague infection, but none was found. In all, 220 samples of milk were examined for tubercule bacilli, and in no instance was evidence of tuberculosis found—an excellent record. The year was notable for the very low incidence of typhoid fever, but diphtheria has continued to be prevalent. The death-rate from cancer increased, and has been increasing steadily for a number of years.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned·—A principal of the York Technical Institute—The Secretary for Education, Education Offices, York (May 18). A junior technical officer in the Admiralty Technical Pool for duty in the experimental section of an Ad-

miralty Establishment at Portsmouth—The Secretary of the Admiralty (C.E Branch), Whitehall, S.W 1 (May 18). A head of the mathematics department of the Dundee Technical College and School of Art—The Secretary, Technical College, Dundee (May 20). A part-time demonstrator in biology at King's College of Household and Social Science—The Secretary, King's College of Household and Social Science, Campden Hill Road, W 8 (May 22). A woman lecturer in geography at the Hull Municipal Training College—The Principal, Municipal Training College, Hull (May 22) Physicists and electrical engineers on the staff of the Radio Research Board of the Australian Commonwealth Council for Scientific Research—F. L. McDougall, Australia House, Strand, W.C 2 (May 26). A horticulturist and an agricultural lecturer and warden at the Kent County Farm Institute at Borden —The Agricultural Organiser, Springfield, Maidstone (May 27). A principal of the Technical College and Junior Technical School, Horwich—J. McLean, Railway Mechanics' Institute, Horwich, Lancashire (May 28). A lecturer in physiology at the Chelsea Polytechnic—The Principal, Chelsea Polytechnic. Manresa Road, S W.3 (May 31). A Government analyst for Cyprus — The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (May 31) A teacher in engineering at the Technical College, Wolverton—The Principal, Technical College, Wolverton, Bucks (June 1) A professor of commerce in the University of Birmingham—The Registrar, The University, Edgbaston, Birmingham (June 7). A professor of physiology in the University of Sydney—The Agent-General for New South Wales, Australia House, Strand, W.C 2 (June 8) A temporary junior assistant in botany in the University of Aberdeen—The Secretary, The University, Aberdeen A chief mathematical master at Whitgift Grammar School, Croydon — The Headmaster, Whitgift Grammar School, Croydon A woman lecturer in mathematics and geography at St. Hild's Training College, Durham—The Principal, St Hild's Training College, Durham A tutor in psychology at Loughborough College — The Registrar, Loughborough College, Leicestershire. An assistant in the public health laboratories and bacteriological department of the University of Durham College of Medicine—The Registrar, University of Durham College of Medicine, Newcastle-upon-Tyne.

Our Astronomical Column.

THE PLANET MERCURY.—This planet will be very favourably placed for observation at the middle of May as an evening star, being at its greatest elongation east of the sun on May 15, when it is placed twenty-two degrees east of that luminary. The planet will set on several nights more than two hours after the sun, and its position near the new moon on the night of May 10 will afford a very interesting spectacle in the west-north-west sky if the weather is clear On the date mentioned, Mercury will set at 9.46 P M. G.M.T., and the moon goes down at 9 45 P.M. The sun sets at 7 33 P.M , so that the phenomenon will be best seen at about 8 30 P M and may be watched until the two objects set. Mercury will be situated to the north-west of the moon about two degrees, and ought to be readily visible for about an hour to an observer who commands a good open view of the west-north-west sky in the region of the horizon. The moon will appear as a very narrow crescent, but should be distinctly observable to the unassisted eye with Mercury in close attendance sparkling with a rosy light and looking more like a star than a planet.

THE CENTRE OF THE GALAXY—There are two papers on this subject in the March issue of *Proc. U S. Nat. Acad. Sci.* Dr O. Struve makes use of the conclusion that the strength of the calcium lines in early-type stars ascribed to interstellar matter is a measure of their distance, the lines becoming stronger as this increases. He has grouped the results for stars within 10° of the galaxy, taking means for every 30° of galactic longitude. The results when plotted show a good approximation to a sine-curve the maximum of which is in galactic longitude 337·6°, with a probable error of 18°. The longitude is only $10\frac{1}{2}$° greater than the value adopted by Shapley for the galactic centre. Hence it strengthens the conclusion that the intensity of the spectral lines is a measure of distance, since the average distance is clearly a maximum towards the centre of the system of stars. It should be noted that the galactic longitude is reckoned from the intersection (in Aquila) of the galaxy with the equator of 1900. Very few astronomers pay any attention to the resolution adopted at the meeting of the International Astronomical Union in 1925 that it should be reckoned from Alpha Cygni, with the view of getting rid of the correction for precession.

Prof H. Shapley's paper contains photographs and diagrams of the central region of the galaxy. There are very brilliant star-clouds to the south of the central line, but much dark matter along this line and to the north of it. It is shown, however, that the dark clouds do not spread very far, and that there are transparent regions outside them where some spiral nebulæ have been photographed, which are evidently extra-galactic The dark clouds may, however, conceal rich star-clouds in the central region, also the mass of the obscuring matter itself is presumably large, so that it seems possible to imagine a sufficient amount of matter in the central region to account for the high velocities of revolution of the stars about this region which Oort, Plaskett, and others have found.

THE DISTANCES OF DARK NEBULÆ —Series 2, No 52 of *Lund Meddelande* contains an investigation by W. Gyllenberg of the distances of two regions where obscuration by dark matter is indicated by paucity of stars. The method used is to make star counts in the obscured region and in a neighbouring unobscured one It is assumed that the dark nebulosity blots out entirely the light of stars behind it, assumptions are made as to the absolute magnitudes of the stars visible in the dark nebula based on general stellar statistics.

Mr Gyllenberg applies his method to two regions. The distance of the dark matter in the America nebula near ξ-Cygni is given as between 440 and 510 light-years (Lundmark had previously found 610). The distance of the dark nebula near S. Monocerotis is given as 250 light-years · in this case Lundmark had found a value 13 times as great. Mr. Gyllenberg confesses himself puzzled by this large difference. He considers that if the colours or spectral types of the stars were considered, a much higher degree of accuracy could be attained.

Research Items.

HEAD-HUNTING.—In Vol. 58, Pt 2 of the *Journal of the Royal Anthropological Institute*, Mr. J H Hutton analyses the head-hunting customs of the Nagas of Assam with the view of elucidating their significance both in that area and generally. Head-hunting has been explained as due either to a desire to obtain human hair for use as ornament or the desire for human beings to send to the next world as slaves of the dead. The latter belief, though present among the Nagas, is not found among the tribes where the practice of head-hunting was most flourishing. The religion of the Naga hill-tribes centres on fertility cults, with which are connected phallic observances and the erection of menhirs. But though these observances secure fertility they are not its source. This seems to lie in the souls of the dead A wooden figure which contained the soul of the dead used to be placed on a grave by the Angami. This was thrown away before the sowing of the millet crop Among the Ao the smoke-dried body of a dead relative was kept in the house until the first fruits were eaten, after which it was disposed of in the usual way. Other customs of a similar character point to the association of the dead body with fertility through its preservation either until the sowing of the seed or until the first-fruit ceremonies, when it was torn to pieces or otherwise treated But among the peoples of Assam the head is more especially regarded as the seat of the soul. This is specifically stated among the Ao and may be inferred from the special sanctity of the head. A soul, for example, among the Konyaks may be transferred to a wooden figure by placing a skull upon it. If, therefore, the soul is a fertiliser and it resides especially in the head, when soul matter is required it may be obtained by cutting off a head and taking it home. Then not only enemies' heads are taken, but also the heads of comrades who fall in battle are cut off and brought back so that the enemy may not benefit by them Women who hesitate to marry a man who has not taken a head may do so from the fear that he may be the less likely to be fertile. This form of belief seems also to underlie the head-hunting customs of Indonesia and the Pacific and may be traced westward and possibly as far as Britain and to neolithic or even palæolithic times

ASYMMETRY AND CROSS-BREEDING —In an address to the Eugenics Society, delivered on April 24, Dr. C. J Bond dealt with hemilateral asymmetry in animals and man and its relation to cross-breeding, and made a stimulating addition to biological thought. He concluded that hemilateral—and sometimes serial—asymmetry is closely associated with previous cross-breeding He contrasted the ancient breeds of cattle, for example, *Bos primigenus* and *Bos longifrons* and others, the horns of which curved either upwards or downwards, with such modern cross-bred animals as the shorthorns, the horns of which frequently curve upwards on one side and downwards on the other Similarly, heterodactyly in fowls is a frequent occurrence in the F^2 product of a cross· while in man there are cases of parents with different sized ear lobes producing children whose right ears resemble those of one parent and left ears those of the other. Other examples were derived from asymmetrical eye-colour in man and animals He argued that just as Mendelian segregation occurs in the formation of gametes, so in the cell differentiation of embryonic development, when the bilateral plan of growth is laid down, there is an analogous segregation of maternal and paternal genes. The degree of asymmetry appears to depend upon the closeness of kinship of the parents, whose physiological compatibility determines the stage at which segregation occurs He hoped that the further study of this dissimilarity *in* the individual, like the study of dissimilarity *among* individuals, would assist genetic research.

BRITISH HERONRIES.—Although it is commonly believed that British heronries have declined during the past few centuries, there is no evidence of such decline in the statistics collected by E. M. Nicholson and his collaborators (*British Birds* for April). The number of heron's nests in England and Wales and part of Ireland in 1928 was between 3900 and 4000, but the English total was by far the greatest (3480 to 3566) not only in absolute numbers, but also in the average number of nests in a heronry, 14 there contrasting with about 7 in Wales and about 8 in Ireland The highest averages occur in the south, Sussex leading with 54-55, followed by Dorset 38, and Essex 36, while at the other end of the scale lies Cumberland with an average of 6, and Northumberland with 6-7. Four English colonies had a total of a hundred or more nests. While in some places there have been marked declines, as at Aldershaw in Sussex, where there are said to have been 400 nests in 1840 and are now only about 80, taking the country as a whole the heron is holding its own or gaining slightly. The Scottish statistics have not yet been thoroughly collected and do not appear here, but will ultimately be published in the *Scottish Naturalist*

CRUSTACEAN FEEDING MECHANISMS —In continuation of their work on the feeding mechanisms of Crustacea, Prof. H. G. Cannon and Dr. S M. Manton (*Trans R. Soc. Edin.*, vol 56, pt. 1, No. 9, 1929) have examined the three living genera of the Syncarida, *Anaspides*, *Paranaspides*, and *Koonunga*. They conclude that the first two genera exhibit two types of feeding, raptatory (*i e* grasping large food particles) and filtratory, essentially homologous with those previously described by these authors in *Hemimysis*. The third genus, *Koonunga*, and probably also *Bathynella*, have given up the filtratory method and feed only on large food masses. The Syncarida can thus be grouped in two series, *Anaspides* and *Paranaspides-Koonunga* and *Bathynella*, comparable with the Peracaridan series, Mysidacea-Isopoda or Amphipoda. Both series commence with forms exhibiting a filtratory mechanism, and through the development of the distal portions of the mouth parts and the suppression of the proximal filtering parts, end in a purely raptatory type. The raptatory mechanisms of *Anaspides* and *Paranaspides* have become modified for scraping up algal slime and similar bottom food by the enlargement of the basal portions of the first trunk limbs. The deviation of the feeding mechanism of *Koonunga* from the dual filtratory and raptatory type seems to have followed the same lines as the evolution of the typical amphipod or isopod type from that of the mysids. The maxilla has become an attenuated biting limb and lost all trace of endopodite and exopodite. The first trunk limbs have not formed a maxillipedal plate as in the higher Peracarida, but their heavy clawed armature and their marked flexure between the merus and carpus suggest that they are used for holding large food masses over the biting mouth parts. The most important characteristic of the *Koonunga* mechanism is the concentration of biting limbs, not around the mandibles at the mouth entrance, but around the distal endites of the maxillule.

GERMINATION OF *CYATHODIUM* SPORES.—The liverwort *Cyathodium*, one of the Marchantiaceæ, for a time wrongly regarded as having a British representative (*Riccia spuria* Dicks.), has recently been investigated by Mr. N. K. Tiwary at Benares, secretary of Benares Hindoo University, who has sent to NATURE a communication on the subject. Mr. Tiwary has succeeded in finding an abundance of germinating spores, though it has not been possible to bring about germination artificially. The spores are unusual in having from two to four germ-pores; they appear to have a distinct polarity, for the germ-tube and rhizoids arise from opposite ends, not from a single pore as is customary. There is variation in the manner of germination; the cell-contents on emerging from the germ pore form either an ovoid mass or a germ-tube. We have thus an addition to those species which have protonemata varying between the two main types.

EARTHQUAKE IN THE ALEUTIAN DEEP.—A great earthquake was registered at the Hawaiian Volcano Observatory (*Volcano Letter* for Mar. 14) at 3 h. 11 m. 22 s. P.M. on Mar. 6 (1 h. 41 m. 22 s. A.M. on Mar. 7, G.M.T.), the long waves being so prominent that the pens of the seismographs swept off the smoked paper. From the duration of the preliminary tremors it was clear that the origin was about 3650 km. from Kilauea. This is the distance of the well-known earthquake region that lies to the south of the Aleutian Islands, and later reports, received from Japanese vessels and elsewhere, show that the epicentre was on the north edge of the Aleutian Deep, a trough more than $4\frac{1}{2}$ miles in depth, and about 100 miles south of Amukta Island. About 7.45 P.M., that is, in little more than $4\frac{1}{2}$ hours later, the first sea-waves reached Hawaii, the largest occurring between 8 and 9 P.M. The range of motion in Hilo Bay was, however, only 16 inches. With the equally strong Alaskan earthquake of Feb. 3, 1923, the sea-waves at Hilo rose about 15 feet above the normal level.

ECHO AND SCATTERING WITH SHORT WAVE RADIO TRANSMISSION.—Radio engineers have been greatly puzzled by the anomalous results obtained when working with radio waves less than 100 metres in length. Partial explanations of some of these results are given in a paper on short wave transmission read by T. L. Eckersley to the Institution of Electrical Engineers on April 10. The main interest in short wave transmission, both from the practical and theoretical points of view, lies in echo and scattering effects. The author classes both these results together, as ultimately the two effects merge into one. He regards the conducting 'layer' as a complex structure of scattering clouds, the scattering being more intense in the lower levels of the layer. Experiments carried out near Chelmsford showed that local signals from Ongar could be balanced almost perfectly by means of a special receiver. On the other hand, signals from Bodmin, Grimsby, the Dutch stations, and a Berlin station at night time (during the period of weak signals) could not be balanced by any adjustment of the circuits. All these stations are within the 'skip' distance. Long distance stations such as Canada, Australia, India, South Africa, Rio, Java, and many other distant beam stations give results which are intermediate between those obtained from near stations and more distant stations lying within the skip distance. The author considers that the direct rays from the beam stations are so weak that their effects can be neglected. The rays received at Chelmsford are those scattered back from the regions where the main transmitting beam penetrates into the scattering region of the conducting layer. He now estimates the effective height of the daylight conducting layer as about 48 miles in summer and 60 miles in winter. The scattering of short waves bears some resemblance to that of a searchlight playing upon the clouds. If the searchlight itself is hidden from view, the point of intersection of the searchlight beam and the scattering clouds appears to be the source.

A NEW THERAPEUTIC LAMP.—Mr. Albert Eidinow describes in the *British Medical Journal* of April 13 a new therapeutic lamp, the novelty of which lies in a closer imitation of the sun's spectrum. Heliotherapy consists in the exposure of the patient's body to the sun's radiations, and to those from the sky, for carefully graded periods, which are increased up to several hours as the patient becomes accustomed to the treatment and as his body pigments; he thus receives long combined doses of short infra-red, intense visible light, and moderately intense 'long' ultra-violet radiations between 3000 and 3200 A.—the latter producing by slow degrees a deep, intense pigmentation. Mercury vapour lamps and arc lamps all produce intense radiations in the ultra-violet at wave-lengths below 3000 A., to which patients can be exposed only for short periods without the production of intense erythemas. The new lamp (Fig. 1) is intended to give radiations more like those of the sun, and to this end a number of small metal-filament glow lamps are used in series to supply visible light and heat in the yellow-red part of the spectrum, while the necessary ultra-violet component and the blue light are supplied by a long vacuum mercury vapour lamp tube, from which intense source all the short radiations are filtered out. To effect this, the tube of the lamp is composed of frosted silica instead of fused quartz, and in addition, a screen of 'sanalux' glass, which cuts off most of the rays below 2900 A., can be interposed between the lamp and the patient. To such a lamp patients may be exposed for several hours, either sitting up or recumbent, in the same way that they may be exposed to the sun in suitable climates, and so may obtain mild applications of long wave-length ultra-violet radiations together with the warming and stimulating heat and light from the glow-lamps. The lamp may be used for photographic purposes and for artificial daylight illumination, as for colour-matching its light is almost indistinguishable from daylight.

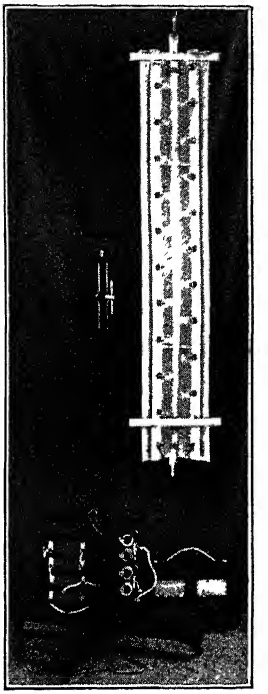

FIG. 1

PHOTOGRAPHING ARTIFICIAL DISINTEGRATIONS.—The practical difficulties which arise in the study of artificial disintegration by the Wilson cloud method are mostly connected with the necessity for taking a very large number of photographs. Approximately

a hundred thousand normal α-trails occur in nitrogen for every one in which disruption of a nucleus takes place, and it is therefore essential to work with recording devices of high efficiency In the issue of the *Proceedings of the Royal Society* for April 6, P M. S Blackett has described a double camera for use with the large Wilson chamber made by the Cambridge Scientific Instrument Company, this takes two sharp photographs of the plane of the chamber on two mutually perpendicular films, a special feature in its design being that the principal plane of each camera lens passes through the line of intersection of the plane of the chamber with that of the corresponding photographic film Mr. Blackett has made a detailed theoretical investigation of the optimum working conditions for this apparatus, and has shown that the magnification of the cameras should be reduced so far as possible towards the limit set by the resolving power of the photographic emulsions It is also found that if the number of tracks photographed in each beam of particles is made too large, there is a falling off in the observable number of resolved collisions Mr. Blackett's paper is illustrated by two interesting plates, one of which shows the camera and Wilson chamber mounted ready for use, and the other some sheafs of α-particles, many of which have secondary δ-trails radiating from them.

SOLID HELIUM —The issue of *Die Naturwissenschaften* for April 19 contains a short communication from the Physikalisch-Chemisches Institut of the University of Berlin, by F Simon, announcing a further extension of the melting curve of helium It had previously been established that helium could be obtained in the solid state at as high a temperature as 20° abs. by the application of a pressure of 1800 atmospheres, and in this new work the transition curve has been followed to 32° abs. and 3500 atmospheres. It is calculated from the data already obtained that it should be possible to solidify helium at the temperature of liquid air under a pressure of 15,000 atmospheres, provided no critical phenomena intervene. As is pointed out, the fact that a substance can exist as a solid at a temperature that is very much higher than the highest temperature at which it can be held liquid when in the presence of vapour—5 2° absolute in the case of helium—may be of considerable significance in connexion with the state of matter in the interior of stars.

RARE EARTHS FOR SPECTROSCOPY.—Adam Hilger, Ltd , have now added a number of rare earths to the list of substances of exceptionally high purity which they can supply for spectroscopic and other purposes. These have been specially prepared for them by Prof. L. Rolla and by Dr. W Prandtl, and every specimen is guaranteed to contain in general not more than 0·1 per cent of total impurity. The ceria and yttria which are now available have, in fact, been used in a similar state by Honigschmid and Auer von Welsbach for determinations of atomic weights, and the dysprosia is claimed to be even better than that used by these investigators. Terbium, holmium, erbium, europium, florenzium, and thulium are also shortly to be placed on the market. Considering the enormous labour involved in the isolation of these bodies, the prices asked for them are very moderate, ranging from only a half-guinea for five grams of Rolla's lanthanum oxide to thirty pounds for a gram of Prandtl's dysprosia Messrs. Hilger also possess a considerable number of scandium compounds which formed part of the collection of Sir William Crookes, which can be had either individually or in the form of mounted museum specimens.

THE ASSAY OF COAL.—In the examination of coal it is found useful to amplify analyses by distillation with measurement of the products so obtained. Such methods give results differing from those of large-scale practice, but, with experience, correlation is possible. One of the many such tests proposed, the Gray-King assay, devised at the Fuel Research Station, has been widely used, and in *Technical Paper* No 21 of the Fuel Research Board (London H.M Stationery Office, 1*s*. net), J G King, C Tasker, and L. J Edgcombe record experiences with the test covering several years It is shown how the assay should be modified to deal with widely divergent materials.

VAPOUR PRESSURES AND DENSITIES OF AMMONIUM CHLORIDE AND IODIDE —The determinations of the vapour pressures and densities of ammonium iodide and chloride made hitherto have shown considerable discrepancies. Purcell and De Lange, whose results are described in the *Journal of the Chemical Society* for February, find that the vapour of ammonium iodide is completely dissociated at all temperatures up to 400°. Their measurements, made between 300° and 400°, are in good agreement with those of Smith and Calvert. The case of ammonium chloride has been investigated by Rodebush and Michalek, and details are given in the *Journal of the American Chemical Society* for March The vapour pressure of this salt appears to be unaffected by intensive drying, but the rates of vaporisation and condensation are considerably decreased The vapour was apparently completely dissociated even when the ammonium chloride had been dried for ten days at 60° in a vacuum.

MAGNESIUM ZINC ALLOYS —The equilibrium diagram of this system has been re-examined by W. Hume-Rothery and E O Rounsefell, and the results were presented at the March meeting of the Institute of Metals, the relations between the magnesium-zinc and the magnesium-cadmium diagrams were also discussed. Both series contain analogous rather unstable compounds, $MgZn_2$ and $MgCd_2$, but whilst the Mg-Cd system contains wide solid solution ranges in the parent metals, the Mg-Zn system shows little solubility in the two metals, but forms two very unstable compounds, $MgZn_5$ and MgZn. The evidence indicates that these exist in the solid state only and not as definite molecules in the liquid. It would seem that some of the numerous unstable compounds met with in alloy systems may not correspond to any definite molecule in the chemist's sense of the word. In these circumstances the following suggestions are put forward in connexion with primary solid solutions and compounds of fixed composition Where two metals form a stable compound there is usually considerable evolution of energy, and we may expect solid solutions to be almost entirely absent. This condition is met with in most of the alloys of the electropositive metals with the border-line metals, such as tin, antimony, bismuth, etc. Where two metals form an unstable compound, primary solid solutions will be formed if the atomic volumes are nearly equal, as are those of magnesium and cadmium. If, however, the atomic volumes differ widely, for example, zinc and magnesium, the tendency is for the main compound to be accompanied by other compounds which exist in equilibrium with the liquid over a very small range of temperature, and may exist only in the solid state representing the patterns into which the different sized atoms can be packed with or without chemical combination, that is, electron transference or sharing.

The Permanently Frozen Soils of Russia.

FOR more than two hundred years it has been known that in the extreme north of Siberia there are soils the lower strata of which are in a perpetually frozen condition Since then a considerable literature on the problem has accumulated, but it is widely scattered, partly in almost inaccessible local publications, and a general critical survey of the literature, together with the results of original observations, recently published by the Far Eastern Geophysical Observatory in Vladivostok,[1] is therefore of great interest.

The author defines these perpetually frozen soils as those the temperature of which is always below the freezing point, regardless of the presence, or absence, of water in the soil This definition is more exact than most of the earlier ones, which have been usually based on the soil being cemented by frozen waters It happens with some sufficiently loose and very dry soils that their particles remain free and the soil loose even after freezing, such soils nevertheless should be classified as permanently frozen

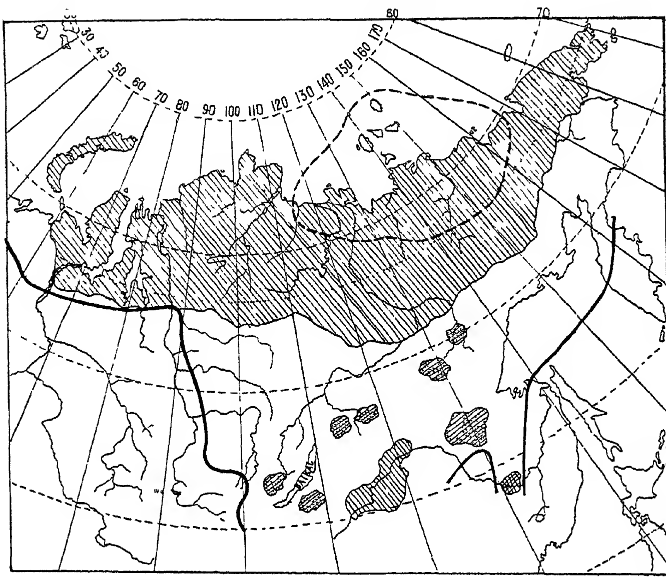

FIG 1—Diagrammatic map of permanently frozen soils of Russia (re-drawn after Soumgin) Oblique lines—continuous areas of permanently frozen soils, oblique lines and dots—areas of permanently frozen soils with 'islands' of normal soils, crossed lines—areas of normal soils with 'islands' of permanently frozen soils, heavy continuous black line—southern limit of permanently frozen soils, heavy interrupted black line—the boundary of the area where considerable strata of solid ice are present in the soil

The geographical distribution of such soils in Russia is at present fairly well known, though the information is still very fragmentary As a matter of fact, there are 336 places where observations on permanently frozen soils have been made, of course these observations vary widely in their scope and in their value However, they are sufficient for a map to be prepared from them (Fig. 1). The whole area of permanently frozen soils in Russia occupies about 7,000,000 sq km, that is, very nearly one-third of the whole territory of Russia, and a little less than the area of Europe, and about the same as the area of the United States or of the whole continent of Australia The southern boundary of permanently frozen soils is, as will be seen from the map, very irregular, in European Russia it begins at the White Sea shores and runs eastwards, almost parallel to the Arctic Circle and a little south of it, up to Turukhansk in Siberia, where it turns sharply south-eastwards until it reaches latitude 50° N., its course beyond the latter is not known, being outside Russian territory in Mongolia, near Blagovestshensk and Khabarovsk the southern boundary of the permanently frozen soils again enters Russia, running in a north-easterly direction to the northern part of Kamtchatka about latitude 60° N.

Inside this enormous region of permanently frozen soils several areas may be distinguished Thus, a very large continuous area of permanently frozen soils occupies the whole extreme north of Siberia along the shores of the Polar Sea, another compact area is situated in Transbaikalia, in the rest of the region 'islands' of permanently frozen soils are scattered

The depths to which soils may be in the permanently frozen condition were determined in a number of cases, and fluctuate from 36·3 m in Pustozersk to 74·68 m in Taldan, Amur province, and even to 116·4 m in Yakutsk, in the latter case the actual depth has not been determined, since non-frozen stratum has not been reached. Detailed observations on the temperature conditions of these soils are still very inadequate. Middendorf, in 1848, made some determinations of temperatures in a shaft at Yakutsk and found that the temperature decreased with the depth, reaching −3° C at 382 ft. below the surface, a constant annual temperature was found at 100 ft. deep From these figures Middendorf determined the lower limit of the permanently frozen soil in Yakutsk at about 600 ft below the surface, but all his observations are somewhat doubtful as to exactitude Much more thorough studies in this respect were made recently at Bomnak, Amur province, but they were restricted to relatively small depths, not exceeding 5 m. The upper limit of permanently frozen soil at Bomnak was found to be at 2·8 m from the surface

During the ten years of observations at Bomnak, a correlation has been observed between the thickness of snow and the seasonal fluctuations of the temperature of the soil In years when snow fell late and was not very thick, the temperature was found to increase with the depth, while in winters with abundant snow it protects the soil from cold and the temperature of the soil decreases with the depth, monthly maxima and minima of temperatures in the soil, at 1·5 metres deep, lagging two months behind the air temperatures. When the upper layers of the soil freeze or thaw, the water contained in them gives up, or absorbs, respectively, the heat energy, thus

[1] "Everfrozen of Soil in the Boundaries of U S S R", by M Soumgin Pp 372 The Far Eastern Geophysical Observatory, Vladivostok, 1927

interfering with the distribution of temperatures in the soil. In this way a 'zero curtain' in the soil is formed which is of the greatest importance for the temperature regime of the soil, this 'zero curtain' does not lie at a constant depth, but moves up or down, according to the air temperature. The amplitudes of the monthly mean temperatures at depths exceeding one metre are very small and rapidly decrease with the depth. Observations in other places lead to the conclusion that three different types of the distribution of temperatures in permanently frozen soils may be distinguished, namely: (1) temperature increases with the depth; (2) temperature decreases with the depth; (3) temperature decreases down to a certain depth, then increases. The distribution of temperatures at greater depths has not been studied since Middendorf's work, but it may be safely assumed that it is very complicated

As regards the origin of permanently frozen soils, many authors consider them to be the result of the present climate, but Soumgin believes that they have remained frozen since the glacial period.

A special chapter of the book is devoted to the study of hydrological conditions in the region of permanently frozen soils, while other chapters deal at some length with the influence of the frozen soils on the surface features, especially the distribution of forest types, and with the practical difficulties in building and other engineering work on frozen soils.

An elaborate programme of studies on permanently frozen soils is put forward by the author, who concludes his interesting monograph with a somewhat startling project for establishing somewhere in the area of permanently frozen soils a refrigerator-museum, where bodies of various animals and men should be deposited in order to be examined and compared with later types after several thousands of years.

Fisheries of Madras.

VALUABLE work by the Madras Fisheries Department is described in the administration report for the year 1926–27 by the Director, Dr B. Sundara Raj (Madras Fisheries Bulletin, vol 22, pp 1-99 Madras 1 rupee. 1928). The report deals mainly with the commercial development of the department as applied to fish, pearl, and chank fisheries.

The Chaliyam Fish Cannery, which was expected to recommence its manufacture during this period, did not operate, as Sir F. A. Nicholson was prevented from undertaking the management of the experimental and manufacturing operations, due to ill-health Yet it is hoped that the cannery will be continued, as it has not been given a chance to prove the commercial possibilities of canning as a remunerative industry, especially as two private canneries started on the model of the one at Chaliyam had not prospered At Tanur, researches were continued on the methods of preserving fish in a fresh condition for sale in the interior markets, of curing, pickling, and tinning bonito, cat-fish, and others for disposal in Japan and other places abroad, and of preparing fish-oil from the liver of sardines. The initial experiments carried out with sodium hypochlorite as a preservative of fish in a fresh condition have shown "that about 200 c.c. of solution (with 1 per cent available chlorine) is sufficient to keep 1 lb. of smaller varieties of fish for over 30 hours". Fish-meal, with a low fat content, was made from chamban (*Caranx crumenopthalmus*), and shrimp by the use of a press more powerful than a hand-press

Investigations for improving the resources of edible fish in inland waters were continued. Despite adverse seasonal conditions, the experiments at Vellore and Chingleput Fort Moat Farms demonstrated the utility of stocking catla. The catla fry from the Godavari channel grew to a length of 1½ to 2 feet in eight months in these farms. For want of material the Hilsa hatching experiments have not been satisfactorily concluded, the gourami (*Osphromenus sp*), the tench, and the carp have flourished in inland waters Experiments are being conducted on the trawling grounds close to the Madras coast to ascertain the possibilities of deep-sea fishing.

In the whole history of Ceylon and Indian pearl fisheries, no more than a single fishery was considered possible in any year For the first time, a fishery was commenced in the autumn of 1926 on Nov. 6 and lasted until Dec 4 This small fishery brought a net profit of Rs. 26,801 Another fishery, which excelled all previous fisheries in its excellent organisation of the camp and in the operations at sea, was opened on Feb 11 and closed on April 30. The time-honoured method of fishing and disposing of the oysters was in vogue, except for the fact that the lots of 500 each were counted at sea on board the depot schooners, to avoid extra wages to the labourers and to minimise the pilfering of pearls by divers on their way back to the shore from the banks Although the usual difficulties which marred the administration of the pearl fisheries in the past, such as wrong locations of banks, epidemics, etc, were circumvented, other adverse factors, such as bad weather, depreciation of the market value of pearls, etc, contributed towards a lower yield of revenue than was anticipated Yet this fishery ranks first among those held within the last hundred years, and the Government realised a net profit of Rs. 172,316. Owing to the pearl fisheries, the chank fisheries suffered a set-back, and only a fourth of the normal catch in a good year was fished. It is interesting to note that steps are being taken to develop the ancient chank bangle industry, and that the initial difficulty in the development of this industry has been overcome.

The marine aquarium continued to be popular. The researches on the development of the edible oyster (*Ostrea madrasensis*), carried out in the laboratory of the aquarium, revealed the fact that the Indian oysters fatten and breed only in low salinities, whereas the English oysters flourish when there is a rise in salinity. The tiles put out at Ennur to collect oyster-spat were attacked in such large numbers by a molluscan pest (*Modiola sp.*) that it is proposed to abandon oyster culture in this locality. It is proposed that, if the Marine Biological Station at Krusadai Island is established, its immediate lines of inquiry should be: (1) Biological investigations with special reference to pearl and chank fisheries, (2) hydrographic and meteorological investigations; and (3) technical and industrial researches with special reference to fishing methods Further, it is suggested that the following laboratories, aquaria, etc., are required to start the proposed lines of research (1) The establishment of three new research laboratories, in addition to the one at Calicut, with adequate facilities; (2) the construction of aquaria at Rameswaram and at Vizagapatam; and (3) the establishment of a bio-chemical laboratory equipped with requisite apparatus and staff to deal with the technology of fishery industries. It is very gratifying to note that the Fisheries Department has continued with success the introduction of elementary education to children of the fishing population, the organisation of the co-operative movement on a wide scale, and the promotion of temperance and other social benefits to the community.

New Rubber Plant from Madagascar.

DR. CHARLES F. SWINGLE, of the U S Department of Agriculture, was working in the Department of Botany of the University of Leeds during the winter of 1927–28 making a study of the vegetative propagation of plants from the anatomical point of view. A problem of practical plant propagation then arose through the decision of the U S Department of Agriculture to try to introduce the rubber plant, *Euphorbia intisy*, from Madagascar into the United States. Dr. Swingle sailed from England at the end of May 1928, joining Prof Henri Humbert, of the University of Algiers, in a collecting expedition in the uplands of Madagascar, and a statement of the results obtained has been issued by Science Service, of Washington, D.C.

Euphorbia intisy grows to be a small tree, some of the largest specimens seen by Dr. Swingle being about 12 ft. high and 5 in. in trunk diameter, although trees 20 ft high with a diameter of about 1 ft are reported As a rubber plant it is remarkable for the ease with which the rubber can be collected. It separates itself from the latex on exposure to air, no elaborate coagulation or smoking process being necessary. Years ago, when the natives of Madagascar were collecting rubber for the French, they would simply cut long gashes in the bark of the tree, and then go round next morning and peel out strips of rubber. Unfortunately, this primitive collecting took place in a time of high rubber prices, with the result that the tree was almost exterminated. Outside Madagascar the species seems to be practically unknown, and there is probably not another living plant outside the island, apart from the specimens now growing in a locked greenhouse in Washington.

These plants will probably provide a very considerable practical problem in vegetative propagation. The species can be propagated from stem cuttings, but it is of slow growth, and years will be required before the stock in the United States can be increased to a point where commercial experiments can be undertaken. Probably its peculiar habit of growth is responsible for the fact that the plant has survived its exploitation in its native haunts in Madagascar. According to Dr. Swingle, the root system consists of chains of tuberous thickenings strung together after the fashion of sausages These tubers are storage organs for water, enabling the plant to survive in the desert through a drought as long as six rainless years. With this system of underground life assurance, the remnants of the rubber forest were able to survive the massacre, and to begin life over again after the activities of the rubber hunters had ceased.

University and Educational Intelligence.

CAMBRIDGE.—The President of the Committee of the Privy Council for Scientific and Industrial Research has approved the application for a grant of £1500 to the University for the erection of the liquid hydrogen plant at the magnetic laboratory.

The following grants have been made from the Worts Fund: £100 to the Zoological Station at Naples, £40 to H. G. Watkins and J. M. Scott towards the expenses of a surveying expedition in Labrador, £50 to Miss S. M. Manton for researches on the fauna of the Great Barrier Reef, £15 to Dr. H Hamshaw Thomas towards the expenses of a fossil-collecting journey in South Africa A grant of £25 has been made from the Balfour Fund to J. T. Saunders for investigations on the hydrobiology of the Swiss Lakes

A Denman Baynes Scholarship at Clare College for research in mathematics, physics, or chemistry, of the annual value of £100, will be awarded in July. Preference will be given to graduates of the University of Cambridge and, *ceteris paribus*, to members of Clare College Applications should be sent to the Tutor of Clare College on or before July 1, with such evidence of qualifications as candidates think fit to submit, and a statement, if possible, of the proposed course of research.

LEEDS —The degree of D Sc has been conferred on Mr H C. Versey for a thesis entitled " Studies in the Tectonics of the North of England ".

LONDON.—The following courses of free public lectures are announced: "The Photo-electric and Photo-chemical Measurement of Light, with Biological Applications", by Dr W. R G. Atkins, at the Imperial College of Science (Royal School of Mines), on May 14, 15, and 16, at 5.30, "The Physiology of Glycogen", by Prof. J. J. R. MacLeod, at the London Hospital Medical College, on May 16 and 17, at 5.30; and "Sweden and the North of Europe", by Prof. Sten de Geer, at Birkbeck College, on May 24, 28, and 30, at 5.30.

Applications are invited for the University Studentship in physiology, value £100. Applications must reach the Academic Registrar of the University, South Kensington, S.W.7, by May 31 at latest

The first annual memorial lecture, instituted in memory of Lord Haldane, late president of Birkbeck College, will be given at Birkbeck College by Lord Justice Sankey on Tuesday, May 14, at 5 30 P.M., the subject being " Lord Haldane's Life and the Adult Education Movement ". The Earl of Lytton will preside.

MANCHESTER —Applications are invited for the Sir Clement Royds memorial scholarship in chemistry of the value of £300 The scholarship is for the encouragement of advanced study and research in chemistry in the faculty of science of the University, and is open to British subjects of British descent, born in or inhabitants of the County of Lancaster, preference being given to the county borough of Rochdale The latest date for the receipt of applications, which should be sent to the Registrar, is June 1

Applications are invited for the Dr. Robert Angus Smith scholarship, value not exceeding £150, the object of which is the encouragement of research in sanitary science. Applications must reach the Registrar of the University by June 1.

THE Ramsay Memorial Fellowship Trustees will consider at the end of June applications for a British Fellowship for chemical research. The value of the Fellowship will be £250 per annum, to which may be added a grant for expenses not exceeding £50 per annum. Particulars as to the conditions of the award are obtainable from the Secretary of the Ramsay Memorial Fellowships Trust, University College, London (Gower Street, W.C 1).

VACATION Courses at Leyden, Holland, in August, in glass-blowing and instrument-making, have been arranged for by the Society for the Advancement of the Training of Instrument Makers. Particulars of the courses may be obtained from Dr. C. A. Crommelin, Physical (Cryogenic) Laboratory, the University, Leyden, to whom applications should be sent before June 8.

ON Jan. 1 the Rockefeller Foundation took over the work in Europe which was previously under the administration of the International Education Board. Dr. Lauder W. Jones, of Princeton University, has been

appointed associate director for the natural sciences of the Rockefeller Foundation. Dr Jones assumed his duties at the beginning of April and will have his headquarters in Paris, carrying on the work as successor to Dr. Augustus Trowbridge.

THE Salters' Institute of Industrial Chemistry is again offering a limited number of fellowships to chemists of post-graduate standing, the object being to afford additional and special training at home and abroad, preparatory to a career in industrial chemistry. The value of each fellowship will be from £250 to £300, and applications must reach the director of the Institute, Salters' Hall, St Swithin's Lane, E C.4, not later than June 1 The Salters' Institute will in July allocate a limited number of grants-in-aid to young men and women employed in chemical works in or near London who desire to extend their education for a career in chemical industry The latest date for the receipt of applications is June 7.

A NUMBER of studentships—'research' and 'advanced study'—not exceeding ten in all, are being offered by the Empire Cotton Growing Corporation for the purpose of (a) enabling graduates who believe that they have a leaning towards research to equip themselves for posts in which work of that type is required, and (b) enabling men to receive such specialised instruction as their previous qualifications and experience show to be most desirable in order to equip them for agricultural posts in cotton-growing countries wherever opportunities for employment may present themselves. The value of each studentship is £250 a year, with certain additional allowances for travelling expenses, books, etc Forms of application can be obtained from the Secretary, Empire Cotton Growing Corporation, Millbank House, 2 Wood Street, Millbank, S W 1. The latest date for the return of forms is June 4.

THE Colston Research Society, which exists to assist research work in the University of Bristol by means of money collected annually, has received this year, in addition to the ordinary collection, the sum of £5000 from one of the Society's oldest subscribers, Mr. R. H. Mardon. The money is to be maintained intact to provide a fund annually for investigation in agriculture or industry in the University of Bristol which is likely to be of benefit to any portion of the British Empire This is the first permanent endowment which has been received. The Colston Research Society was founded thirty years ago, and of recent years has collected annually £700 to £800 Mr. Mardon's gift encourages the hope that further endowments may be forthcoming.

THE Rockefeller Medical Fellowships for the academic year 1929–30 will shortly be awarded by the Medical Research Council, and applications should be lodged with the Council not later than June 1. These fellowships are provided from a fund with which the Medical Research Council has been entrusted by the Rockefeller Foundation and are awarded to graduates who have had some training in research work in the primary sciences of medicine or in clinical medicine or surgery, and are likely to profit by a period of work at a university or other chosen centre in the United States before taking up positions for higher teaching or research in the British Isles. In special circumstances the fellowships may be tenable at centres of research not in America. A fellowship held in America will have the value of not less than £350 a year for a single fellow, travelling expenses and some other allowances will also be paid. Forms of application are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S.W.1.

Calendar of Patent Records.

May 14, 1655.—The patent granted to Sir Edward Ford on May 14, 1655, for his method of "drayning of lands, raysing of water to serve citties or houses, as likewise for cleering, drayning, and avoiding of springs from mynes and quarries" is the only one to be found on the Commonwealth patent rolls Ford erected pumps, worked by a horse-gin, on a site between Somerset House and Arundel House, opposite the present Surrey Street, for supplying water to London direct from the Thames. The pumps remained working for several years, but were ordered to be pulled down by Charles II because "the great fabric of wood" was a nuisance, especially to Denmark House, the residence of Queen Henrietta Maria

May 14, 1825—Sir Goldsworthy Gurney's steam road-carriage, which he patented on May 14, 1825, was provided, in addition to the ordinary piston engine driving the wheels, with adjustable propelling legs which acted successively against the surface of the road to assist the coach up hills A contemporary drawing shows that it was a six-wheeled vehicle

May 15, 1824.—The machine for making solid-headed pins which was the subject of the English patent granted to the American, Lemuel Wellman Wright (on behalf of a kinsman in the United States), on May 15, 1824, was not the first of its kind to be patented, but was the first to achieve commercial success, though it was many years before pins made by the old process dropped out of the market The manufacture started by the inventor in London failed, but the patent was acquired by Messrs Taylor and Co., of Stroud, Gloucestershire, who spent a large sum of money in perfecting the machine. The life of the patent was extended for five years by the Privy Council.

May 15, 1832.—The steam plough with stationary engine and cable was patented by John Heathcoat on May 15, 1832 The patent foreshadowed also the use of 'caterpillar' wheels for agricultural machinery To enable the apparatus to be worked on soft ground, the engine was fixed on a carriage of large dimensions and mounted on a series of wheels which conducted "an endless flexible floor, railroad, or way," within and upon which the carriage was caused to travel. The 'flexible floor' was made of painted or tarred sail-cloth stretched on strips of metal

May 15, 1844.—The first industrial application of gutta-percha was in the manufacture of cork stoppers and other articles, and was patented by Charles Hancock on May 15, 1844 The new material only became known in England the previous year, when specimens of it were exhibited for the first time at the Society of Arts.

May 16, 1674.—The patent granted for seven years to George Ravenscroft on May 16, 1674, for "his new invention or art and manufacture of a certaine christeline glasse resembling rock christall not formerly used in this kingdome" was a landmark in the history of English glass. From it dates the introduction of the flint glass industry of England which dominated the European markets for many years.

May 16, 1862—The bicycle did not become popular until about 1865, when Ernest Michaux of Paris introduced what became generally known as the 'boneshaker,' which had pedals fitted directly to an enlarged front wheel. But a notable contribution to its success as a means of transport was made by Albert Louis Thirion, a Belgian resident in London, who on May 16, 1862, was granted in England the first patent for roller or ball bearings for use on velocipedes

Societies and Academies.

London

Royal Society, May 2 —J S. Haldane, W. Hancock, and A. G. R. Whitehouse . The loss of water and salts through the skin, and the corresponding physiological adjustments The paper contains data as to the nature and percentage amounts of salts lost from the skin without sweating and in different stages of free sweating The disturbance produced when loss of salts and water is replaced by gain of pure water is ordinarily prevented by the compensatory action of the kidneys and a natural craving for salt What is kept practically constant is the diffusion pressure of water within the body, in accordance with Claude Bernard's conception of the blood as an internal environment maintained constant by the co-ordinated action of organs —F. H A. Marshall and J Hammond Œstrus and pseudo-pregnancy in the ferret 'Heat' is prolonged in absence of coitus. The vulva enlarges to about fifty times its anoestrous size and persists to cessation of heat Ovulation occurs at any time during heat, but only after coitus Details are given of the uterine changes All changes are apparently controlled by the corpus luteum The vulva affords no external indication of the luteal phase which is the main factor in the developmental changes.—R G. Canti and F. G Spear : The effect of gamma irradiation on cell division in tissue culture *in vitro*. The fall in the number of cells undergoing mitosis was followed by a rise which, with a certain exposure and intensity, was compensatory to the fall With longer exposures, though there was a tendency to rise, the number of cells undergoing mitosis never reached the normal —R. B. Bourdillon, C. Fischmann, R. G. C. Jenkins, and T. A. Webster . The absorption spectrum of vitamin D By the action of ultra-violet radiation on ergosterol three substances (or groups of substances) are produced in succession The first shows an absorption band roughly similar to that of ergosterol (maximum $280 m\mu$), but more than twice as intense, and has great antirachitic activity It is probably vitamin D Neither the second nor the third substance has antirachitic activity, though the former shows a strong absorption band at $240 m\mu$. The actual percentage of vitamin D present in the purest preparations studied is estimated as above 50 —G. E. Briggs Experimental researches on vegetable assimilation and respiration (20) —R J Lythgoe and K Tansley The relation of the critical frequency of flicker to the adaptation of the eye. The critical frequency due to the cones falls during dark-adaptation and with decreasing levels of light-adaptation and is highest with equally bright surrounds That due to the rods behaves in the opposite fashion. The peripheral cones are functionally not identical with the foveal cones. The brightness of the surrounds is the most important factor in determining whether the critical frequency relations are of the rod or cone type, bright surrounds encouraging the cones and dark surrounds the rods.—R. Hill . Reduced hæmatin and hæmochromogen.—G. R. de Beer · The development of the skull of the shrew —J. W. Pickering : The influence of Witte's 'peptone', and of digestion on blood platelets and plasma —F. W. R. Brambell and A. S. Parkes : Compensatory hypertrophy of the untreated ovary after unilateral X-ray sterilisation —W. Moppett The differential action of X-rays in relation to biology, chemistry, and physics (Part I).—C. H. Browning, J. B. Cohen, S. Ellingworth, and R. Gulbransen · The trypanocidal action of some derivatives of anil and styryl quinoline.

Paris.

Academy of Sciences, April 8.—P Villard : The devitrification of glass. Experiments are described leading to the conclusion that devitrification of glass is the consequence of a loss of sodium or potassium, and practical suggestions are made for working glass before the blowpipe so as to reduce devitrification to a minimum.—G. Vranceanu : The three points of view in the study of non-holonome spaces —Georges Giraud The solution of the problem of Dirichlet for linear equations —Krawtchouk The approximate solution of linear integral equations —Mlle Nina Bary: Some mixed forms of the finite representation of an arbitrary continuous function —J. A. Lappo-Danilevski Fundamental problem of the theory of functions in the class of matrices satisfying systems of differential equations with rational coefficients.—Benjamin Meisel The approximate definition of the relative kinetic energy of a liquid filling a rotated vase. —E Sevin · The Compton effect and its inverse —Antoine Willemart . The absorption spectra of the rubrenes. Curves are given of the absorption spectra of the three known rubrenes, rubrene, dimethylrubrene, and bibenzorubrene Each has the same number of bands similarly placed, and the three maxima on each curve have identical wave-lengths —H Damianovich and J. J. Trillat Researches on the action of helium on platinum Under the influence of an electric discharge at low pressure, platinum retains large quantities of helium. Examination of the substance produced by means of the X-rays, using the Debye-Sherrer method, did not give very definite results, but there were some indications of the presence of a new micro-crystalline compound, probably a combination of helium and platinum —Galibourg · The effect of extension and ageing on the elastic limit of metals —J. Cournot . The influence of the dimensions of the test pieces in measurements of the viscosity of metallurgical products. The dimensions of the test piece have a marked influence on the flow of the metal · the practical limit of the viscosity increases with the diameter of the test piece Data are given for aluminium wires —Lespieau and Wiemann · The preparation of acetylenic hydrocarbons with the aid of epidibromhydrins. Details of the products of the reaction between methyl magnesium bromide and the epidibromhydrin containing five atoms of carbon. —V. Agafonoff : The determination of the mass of carbon and constitutional water contained in the soils of the terrestrial globe.—Henry Hubert The monthly rainfall curves at Madagascar.—Guilliermond : New remarks on the Golgi apparatus the Golgi apparatus in the yeasts. Additional proofs, with illustrations, are given of the author's view that there exists no Golgi apparatus independent of the chondriome and the vacuome —L Marrassé : Hexamethylenetetramine and formaldehyde are true foods for the bean The conclusions of E and G Nicolas, based on the method of cultures, are confirmed by a cytophysiological method . hexamethylenetetramine and formaldehyde, in proportions of 0 2 per thousand of the former and 0·16 per thousand of the latter, form true foods for the cells of the bean —I. D. Strelnikov : The fauna of the Sea of Kara and its ecological conditions. —G Frank and M. Popoff : The mitogenetic radiation of the muscle in contraction. The mitogenetic radiation can only be the product of the explosive glycolysis which occurs precisely at the period of latent irritation and at the commencement of the contraction —P. Delanoe The presence of the *Ornithodorus* of Morocco in the burrows of porcupines and foxes and in human habitations. Its existence in eastern Morocco. Frequency of a recurrent spirochæte in the *Ornithodorus* of these burrows

GENEVA.

Society of Physics and Natural History, Feb 21.—E. Cherbuliez and P. Plattner: A new method of separation of the amino acids in the form of their acetyl esters. The principles of this separation are as follows (1) hydrolysis by hydrochloric or sulphuric acid at the boiling point, (2) esterification of this solution by alcoholic hydrochloric acid, (3) acetylation of the syrup obtained by concentrating the solution of the hydrochlorides of the esters by treatment with acetic anhydride and sodium acetate in excess —E. Cherbuliez and S. Ariel. A new method of disintegrating the proteids and the problem of the size of the molecules of the scleroproteins The authors have studied the solubility of the following scleroproteins in acetamide at 200° C and in urea at 140° C.: fibroin, keratin (dog's hair, ox hair), elastin (ox) The latter is insoluble in both solvents at the temperatures given above, the keratins are both soluble, the fibroin soluble in urea and partially soluble in acetamide (28 per cent in 30 minutes) The process of solution is accompanied by a profound modification of the chemical character of the proteids utilised, and this is probably due to an intramolecular transposition.—G. Dejardin: The progress realised in the preparation and use of thermionic cathodes The author describes particularly the cathodes consisting of a metallic nucleus with a superficial layer, probably monatomic, of another metal The cathode nucleus is a tungsten wire covered superficially with an oxide, such as copper oxide, susceptible of being reduced by barium vapour at a moderately high temperature The barium salt of hydrazoic acid, BaN_6 is utilised —R. Chodat: The theory of generalised mutation and mutations in *Chlorella rubescens*. By cultures derived from a single cell, carried out with the micromanipulator of Janse and Peterfi, the author ascertains from several generations that the general law is not constancy but micromutation. In the colonies, the micromutants are, as it were, merged in the whole and escape observation —Arnold Pictet: The reconstitution of a dominant character by crossings between recessives —Ed Parejas: Geological observations in Corsica (2) The autochtone sediment of Popolasca. At Popolasca, the Mesozoic presents facies comparable with those of Malm and of the Helvetian Infravalanginian (autochtone of Gastern and Doldenhorn stratum). One of these limestones contains authigen albite. A thin layer of granite not hitherto pointed out overlaps the series of Popolasca —G. Tiercy: Concerning the gain and loss of chronometers (2). To the considerations developed in an earlier note, where the author gives the relation correction = –(rate) he adds some further remarks taken from the meaning attributed to the word 'etat' in finance and in rational mechanics. He stresses the fact that the word 'etat' (rate) is employed in relation to watches, not only at the Geneva Observatory but also at Kew and at Besançon.

ROME.

Royal National Academy of the Lincei, Jan. 20.—F. Severi and B. Segre: Further with regard to a topological paradox (2) —G. Giorgi and Ernesta Porcu-Tortrini. Motions of deformation in space represented by means of matrix calculus —U. Cisotti: The triple tensor of Christoffel —F Zambonini and Silvia Restaino. Double sulphates of the rare earth and alkali metals. (12) Cerous and cæsium sulphates. Study of the isotherm of the system, $Ce_2(SO_4)_3 - Cs_2SO_4 - H_2O$, at 25° indicates the existence of the compound $Ce_2(SO_4)_3$, Cs_2SO_4, $8H_2O$, which is stable within moderately wide limits.—S. Franchi: Non-existence of the great faults known as the Monte Rosa bowl and of the Great St Bernard bowl in the Western Alps Study of the tectonics of the Franco-Italian Cottian Alps indicates that the Monte Rosa bowl (V) and the Great St Bernard bowl (IV.) have no real existence, and that, in the western Alps, the contact between the permian, attributed to fold IV., and the calc-schisto, attributed to V, is a normal contact —B. Segre: Construction of a simple oblique Jordan's curve —A. Mambriani. A particular differential equation. Scorza Dragoni has recently indicated briefly the method, to be published fully later, used to demonstrate the existence and unicity of the solution of the differential equation, $y'' = y^{\frac{3}{2}} x^{-\frac{1}{2}}$, with the limiting conditions $y(0) = 1$, $y(+\infty) = 0$, which arises from certain physical investigations of Fermi. It is now shown that the existence and unicity of the equation in question may be deduced at once from classical propositions on ordinary differential equations, in conjunction with elementary observations on the particular form of the equation.—Rita Liceni. The form F_2 of Fubini. For the surfaces in a four-dimensional space S_4, Fubini found a form indicated by him by F_2 which has a projective character. Later, in the study of certain varieties, Vitali encountered a form F_2, also of projective character, and showed that, in the case of the surfaces in S_4, his F_2 coincides with that of Fubini. The author now develops the analytical passage from one form to the other —J. Kaucký: Surfaces of which a canonical straight line passes through a fixed point —F Cecioni: Conform representation of pluri-connected areas belonging to a Riemannian surface —A. M. Bedarida Systems of arithmetical progressions —G Krall Upper limitations for the dynamic displacement in elastic systems Higher limits are assigned to the displacement of an elastic body, vibrating under the action of either constant or time-variable forces, starting from the more general initial circumstances of the motion —A. Carrelli: The new diffusion phenomenon the Raman effect. It is shown that, as for Tyndall light, the intensity of Raman light is directly proportional to the fourth power of the emitted frequency and is dependent also on magnitudes characteristic of the lines in the dispersion formula of the substance considered.—T. G. Levi Dithioformic acid (2) Various derivatives of dithioformic acid, obtained by the action of chloroform on potassium sulphide. The acid, now isolated in the pure form as a white solid melting and decomposing at 55°-60°, decomposes into hydrogen sulphide, carbon disulphide, carbon, and sulphur, when heated. The results of molecular weight determinations indicate that the acid and its esters exist as trimerides, and a cyclic structure with alternate carbon and sulphur atoms is suggested. Two isomeric benzyl esters exist, the isomerism being probably of the cis-trans type.—F. Rodolico: Crystallographic investigations on cinnabar from Idria.

VIENNA.

Academy of Sciences, Feb 21.—E. Beutel and A. Kutzlnigg: The action of potassium ferrocyanide on silver and some slightly soluble silver compounds.—W. Leithe. The natural rotation of polarised light by optically active bases (2). The rotation of *d*-*a*-phenyl-ethyl-amine and its chlorhydrate in solution, with remarks on the rotation of active tetra-hydroquinaldine —E. Haschek A contribution to the theory of photochemical phenomena. Concerning the retina of the eye.—K. Schnarf. The embryology of Liliaceæ and its systematic significance —M. Holly: Three new fish forms from Persia. *Barbus* and others, including a cyprinodon from warm springs.

Official Publications Received.

BRITISH

The Tea Research Institute of Ceylon Bulletin No 3 Annual Report for the Year 1928 Pp 67+3 plates (Kandy)

Memoirs of the Department of Agriculture, Trinidad and Tobago No 4 The Useful and Ornamental Plants of Trinidad and Tobago By W G Freeman and R O Williams Second edition, revised Pp iv+192 (Trinidad, B W I Government Printing Office, Port-of-Spain)

Ceylon Journal of Science, Section A, Botany Annals of the Royal Botanic Gardens, Peradeniya Edited by A H G Alston Vol 11, Part 2, March 12th Pp 113-211+plates 16-24 (Peradeniya Director of Agriculture, London Dulau and Co, Ltd) 3 rupees

The Indian Forest Records Entomology Series, Vol 13, Part 5 Epidemic Attacks by the Sal Heartwood Borer (*Hoplocerambyx Spinicornis*, Newm, fam Cerambycidae) in the Forests of South Mandla Division, Northern Circle, Central Provinces, with special reference to the Period 1924-25 to 1926-27 By Wm Angus Muir Pp ii+76+12 plates (Calcutta Government of India Central Publication Branch) 2 10 rupees, 4s 9d

British Museum (Natural History) Picture Postcards Set F29, British Trees Smooth-leaved Elm 2 cards in Colour and 2 in Monochrome 6d Set F30, British Trees Wych Elm 2 cards in Colour and 2 in Monochrome 6d Set F31, British Trees Scotch Fir 2 cards in Colour and 2 in Monochrome 6d Set F35, British Trees Common Oak 2 cards in Colour and 2 in Monochrome 6d Set F37, British Trees Hazel 2 cards in Colour and 2 in Monochrome 6d (London British Museum (Natural History))

Australia Commonwealth Forestry Bureau Third British Empire Forestry Conference, Australia and New Zealand, 1928 Papers Presented Pp 905 Commonwealth Handbook Pp 42 Summary Report, Resolutions and Reports of Committees Pp 67 (Canberra, F C T H. J Green)

Empire Forestry Conference, Australia and New Zealand, 1928 Forestry Handbook for New South Wales Pp 48 (Sydney, N S W Alfred James Kent)

Report of the Kodaikanal Observatory for the Year 1928 Pp 4 (Calcutta. Government of India Central Publication Branch)

Education (Scotland) Report for the Year 1928, by the Director, on the Royal Scottish Museum, Edinburgh Pp 9 (Edinburgh)

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 67, No 388, April Pp 437-556+xxxvi (London E and F N Spon, Ltd) 10s 6d

Air Ministry Aeronautical Research Committee Reports and Memoranda. No 1190 (Ae 352) Wind Tunnel Experiments on the Design of an Automatic Slot for R A F 31 Section By F B Bradfield and F W G Greener (T 2656.) Pp 11+5 plates (London H M Stationery Office) 9d net

Reorganisation and the Teaching Profession Being a Statement, supplementary to the "Hadow Report and After", by the Executive of the National Union of Teachers, upon some of the Professional Problems which arise in connection with the Reorganisation of Public Elementary Schools now Proceeding Pp 32 (London National Union of Teachers) Free.

World's Poultry Congress, Crystal Palace, London, England, July 22 30, 1930 Preliminary Announcement Pp 24 (London Ministry of Agriculture and Fisheries)

History of the West Kent Scientific Society (1852-1921) By John M Stone Revised to 1928 and including List of Past Presidents and Secretaries (London Hon Secretary, 15 St German's Place, S E 3)

Proceedings of the Royal Society of Edinburgh, Session 1928-1929 Vol 49, Part 1, No 7 The Correlation between Product Moments of any Order in Samples from a Normal Population By Dr John Wishart Pp 78-90 1s Vol 49, Part 2, Nos 10, 11, 12 Studies in Embryonic Mortality in the Fowl i The Frequencies of various Malpositions of the Chick Embryo and their Significance, by F B Hutt, ii Chondrodystrophy in the Chick, iii Chick Monsters in relation to Embryonic Mortality, by F B Hutt and Dr A W Greenwood Pp 118-155+5 plates 5s Vol 49, Part 2, No 13 The Hydrogen-Chlorine Flame By Dr E B Ludlam, H G Reid and G S Soutar Pp 156-159+1 plate 9d (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd)

University of Leeds Publications and Abstracts of Theses by Members of the University during Session 1927-28 Pp 31 (Leeds)

The Scientific Proceedings of the Royal Dublin Society Vol 19, N S, No 19 Coniferae, Keys to the Genera and Species, with Economic Notes By H M FitzPatrick Pp 189-260+plates 9-15 (Dublin Hodges, Figgis and Co, London Williams and Norgate, Ltd) 8s

Canada Department of Mines Mines Branch Investigations of Mineral Resources and the Mining Industry, 1927 (No 694) Pp iv+60 (Ottawa F A Acland)

The Hudson Bay Region By F H Kitto Pp vii+50 (Ottawa Department of the Interior, Natural Resources Intelligence Service, London High Commissioner for Canada)

Journal of the Federated Malay States Museums Vol 8 Results of an Expedition to Korinchi Peak, Sumatra Part 3 Invertebrates Pp 175-204 (Kuala Lumpur) 50 cents, 1s 6d

Queensland Department of Mines Geological Survey of Queensland Publication No 276 Geology of the Bowen River Coalfield By J H Reid Pp viii+107 (Brisbane Anthony James Cumming)

Abstracts of Dissertations approved for the Ph D, M Sc and M Litt Degrees in the University of Cambridge for the Academical Year 1927-1928 Published by Authority Pp 88 (Cambridge At the University Press)

The National Physical Laboratory Report for the Year 1928 Pp vi+283+13 plates (London H M Stationery Office) 9s net

The Welsh Journal of Agriculture. the Journal of the Welsh Agricultural Education Conference Vol 5 Pp 260 (Cardiff University of Wales Press Board) 2s 6d

Union of South Africa Report of the South African Museum for the Year ended 31st December 1928 Pp ii+12 (Cape Town)

Committee of Civil Research Radium Sub-Committee Report (Cmd 3303) Pp 31 (London H M Stationery Office) 6d net

Journal of the Indian Institute of Science Vol 12A, Part 1 Phototropic Compounds of Mercury. By Bh S V Raghava Rao and H E Watson Pp 16 1 rupee Vol 12A, Part 2 Photoelectric Emission from Phototropic Mercury Compounds By Bh S V. Raghava Rao and H E Watson Pp 17-29 12 annas Vol 12A, Part 3 Attempts to Synthesise *Ortho*-thiolphenylhydrazine By Praphulla Chandra Guha and Tajendra Nath Ghosh Pp 31-35 6 annas Vol. 12A, Part 4 i Characterisation of very small Quantities of Proteins by Van Slyke's Method, by Nuggihalli Narayana and Mothnahalli Sreenivasaya, ii The Determination of Pyruvic Acid, by Basettihalli Hanumantha Rao Krishna and Mothnahalli Sreenivasaya Pp 37-51 12 annas (Bangalore)

Department of Scientific and Industrial Research Building Science Abstracts Compiled by the Building Research Station and published in conjunction with the Institute of Builders Vol 2 (New Series), No 3, March Abstracts Nos 400 589 Pp v+97-132 (London H M Stationery Office) 9d net

FOREIGN

Smithsonian Miscellaneous Collections Vol 81, No 8 Parasites and the Aid they give in Problems of Taxonomy, Geographical Distribution and Palaeogeography By Maynard M Metcalf (Publication 3010) Pp 36 Vol 81, No 11 Atmospheric Ozone, its Relation to some Solar and Terrestrial Phenomena By Frederick E Fowle (Publication 3014) Pp 27 (Washington, D C Smithsonian Institution)

Department of the Interior U S Geological Survey Bulletin 797-C Preliminary Report on the Sheenjek River District, Alaska By J B Mertie, Jr (Mineral Resources of Alaska, 1926-C) Pp ii+99-123+1 plate 10 cents Bulletin 797-D Surveys in Northwestern Alaska in 1926 By Philip S Smith (Mineral Resources of Alaska, 1926-D) Pp ii+125-142+1 plate 5 cents Bulletin 805 A Platinum and Black Sand in Washington By J T Pardee (Contributions to Economic Geology, 1928, Part 1) Pp. ii+15 5 cents Bulletin 810-A Mineral Industry of Alaska in 1927, and Administrative Report By Philip S Smith (Mineral Resources of Alaska, 1927-A) Pp ii+85+xiii Water-Supply Paper 589 Surface Water Supply of the United States, 1924 Part 9 Colorado River Basin. Pp v+159 25 cents Water Supply Paper 597-A Geology of Reservoir and Dam Sites with a Report on the Owyhee Irrigation Project, Oregon By Kirk Bryan (Contributions to the Hydrology of the United States, 1928.) Pp iv+72+10 plates 30 cents (Washington, D C Government Printing Office)

State of Illinois, Department of Registration and Education Division of the Natural History Survey Bulletin, Vol 17, Art 12 The Bottom Fauna of the Middle Illinois River, 1913-1925, its Distribution, Abundance, Valuation and Index Value in the Study of Stream Pollution By R E Richardson Pp 385-475. (Urbana, Ill)

Smithsonian Institution Bureau of American Ethnology Bulletin 84 Vocabulary of the Kiowa Language By John P Harrington Pp v+255 (Washington, D C Government Printing Office) 75 cents

State of Connecticut State Geological and Natural History Survey Bulletin No 44 Report on the Water Resources of Connecticut By Prof Roscos Henry Suttie (Public Document No 47) Pp 168 (Hartford, Conn)

Bernice P Bishop Museum Bulletin 50 The Breadfruit of Tahiti By Gerrit Parmile Wilder Pp. 83 Bulletin 51 Fossil Marine Mollusks of Oahu By Jens Mathias Ostergaard Pp 32+2 plates Bulletin 52 Cornaceae and Allies in the Marquesas and neighbouring Islands By Forest B H Brown. (Bayard Dominick Expedition, Publication No 13) Pp 22 Bulletin 53 Archæology of Nihoa and Necker Islands By Kenneth P Emory (Tanager Expedition, Publication No. 5) Pp 124+23 plates Bulletin 54 String Figures from Hawaii, including some from New Hebrides and Gilbert Islands By Lyle A Dickey. Pp 169+2 plates. Bulletin 55 Fringing and Fossil Coral Reefs of Oahu By James B. Pollock Pp 56+6 plates Bulletin 56 Check List of Hawaiian Land and Fresh Water Mollusca By Edward L Caum Pp 79 Bulletin 57 Report of the Director for 1927 By Herbert E Gregory Pp 38 Memoirs of the Bernice P Bishop Museum, Vol 10 The Fishes of Oceania By Henry W Fowler Pp iii+540+49 plates (Honolulu, Hawaii)

Meddelande från Lunds Astronomiska Observatorium. Ser 2, Nr 52 On the Distribution of the Apparent Magnitudes of the Foreground Stars of Dark Nebulae By W Gyllenberg Pp 25 (Lund C W K. Gleerup)

Publications of the Astronomical Institute of the University of Amsterdam No 2 Researches on the Structure of the Universe By A Pannekoek 2 The Space Distribution of Stars of Classes A, K and B, derived from the Draper Catalogue, 3 The Cape Photographic Durchmusterung Pp ii+87 (Amsterdam)

United States Department of Agriculture Technical Bulletin No 89. Biology of the European Red Mite in the Pacific Northwest By E J. Newcomer and M A Yothers. Pp 70 (Washington, D C Government Printing Office) 15 cents

Zoologica Scientific Contributions of the New York Zoological Society Vol 10, No 1 The Fishes of Port au-Prince Bay, Haiti, with a Summary of the known Species of Marine Fish of the Island of Haiti and Santo Domingo By Dr William Beebe and John Tee-Van Pp. 279. (New York City)

Smithsonian Miscellaneous Collections Vol 81, No 10 Tropisms and Sense Organs of Lepidoptera By N E McIndoo (Publication 3018) Pp 59 (Washington, D C Smithsonian Institution)

Ministry of Public Works, Egypt Physical Department The Measurement of the Discharge of the Nile through the Sluices of the Aswan Dam Final Conclusions and Tables of Results By Dr H E. Hurst and D A. F Watt (Physical Department Paper No 24) Pp. v+44+5 plates. (Cairo Government Press) 10 P T

CATALOGUES

Catalogue of Books on Chemistry and Chemical Technology Pp 56. (London H K Lewis and Co, Ltd)

Zenith Resistances and Rheostats Pp 36+16+12. (London Zenith Electric Co, Ltd)

Photography in Comfort Pp. 36 (London Burroughs Wellcome and Co)

Diary of Societies.

FRIDAY, MAY 10

ROYAL ASTRONOMICAL SOCIETY, at 5 —Prof E. Hertzsprung The Pleiades (George Darwin Lecture) —E A. Kreiken On the Dwarf Nature of Double Stars

PHYSICAL SOCIETY (at Imperial College of Science), at 5 —Dr W E Sumpner Heaviside's Fractional Differentiator —J H. Awbery A Simple Method of Fitting a Straight Line to a Series of Observations —E W H Selwyn Arc Spectra in the Region λ1600–λ2100 —Dr K. R Rao The Spectrum of Trebly-ionised Thallium —G A Wedgwood The Elastic Properties of Thick Cylindrical Shells under Internal Pressure —A Demonstration relating to Standards of Length and Mass, by J E Sears

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (at Abbey Hotel, Kenilworth), at 5 30 —Discussion on Stare Bridge, D H Brown, Kenilworth Castle and Town, S Douglas

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5 30 —Annual General Meeting

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6

INSTITUTION OF MECHANICAL ENGINEERS, at 6 —Special General Meeting

ROYAL SOCIETY OF ARTS (Indian Meeting), at 8 —Captain P Johnston-Saint An Outline of the History of Medicine in India (Sir George Birdwood Memorial Lecture)

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (Annual General Meeting) (at Victoria Hall, Criterion Restaurant), at 8 30 —Discussion on How can the Chemical Engineering Group best assist in the Development of the Science and Practice of Chemical Engineering?

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Prof A E Boycott The Twist of Snail Shells

SATURDAY, MAY 11.

BIOCHEMICAL SOCIETY (in Department of Biochemistry, University Museum, Oxford), at 3 —K H Coward, K. M Key, and B. G E Morgan Some Evidence of the Existence of a Further Factor Necessary for Growth of the Rat —H Bainbridge, E Boock, and J Trevan The Growth of Rats on Synthetic Diets.—C R Harington and D A. Scott Observations on Insulin —F H. Carr, K Culhane, A T Fuller, and Dr G W. F Underhill A Reversible Inactivation of Insulin —W L Dulière, R H Morton, and Dr. J. C Drummond The Alleged Relation between Carotene and Vitamin A —H J Phelps The Mechanism of the Adsorption of Weak Electrolytes —H W Kinnersley and R A Peters. Observations upon Carbohydrate Metabolism in Avitaminous Birds —R A Peters The Third Factor of Williams and Waterman —B Woolf The Enzymes in *B coli communis* which act on Fumaric Acid —E Boyland The Lag between Phosphate Esterification and Carbon Dioxide Evolution in Alcoholic Fermentation —Demonstrations —Tachycardia in Rice-fed Pigeons, by C W Carter and R A Peters —Bios Testing, by Dr G L. Peskett

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute), at 3.—Miss E H Walters Is there a Common Factor of Sensorial Retentivity, and is it Influenced by Conation?—S E W Taylor A Balance Showing the Relation of Blood Distribution to Mental Activity —J W Caughey. Some Factors Involved in the Performance of Single Routine Tests

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Wales District) (at Council Chamber, Swansea), at 3 15 —Discussion on Some Road and Other Schemes at Swansea, R Hudson, Swansea Main Drainage Scheme and Flood Relief Schemes, J Hassall, Llansamlet Sewage Pumping Scheme, Swansea, M E Habershon

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Sections) (at Harrogate) —Annual Meeting

MONDAY, MAY 13

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8 30. —E B Worthington The Life of the Albert Nyanza and Lake Kioga

TUESDAY, MAY 14

PHYSICAL SOCIETY (jointly with Society of Glass Technology) (in Research Laboratories of the General Electric Co, Ltd, Wembley), at 4 —Prof W. E S Turner and F Winks A Study of the Thermal Expansion of Glass up to the Softening Temperature —R F Proctor and R W Douglas The Measurement of the Viscosity of Glass at High Temperatures by Means of the Rotating Cylinder Viscometer —F C Harris The Photo-Elastic Properties of Glass

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Sections), at 5 —Annual General Meeting

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5 30 —G B Maxwell and Dr R. V Wheeler Flame Characteristics of 'Pinking' and 'Non-Pinking' Fuels Part II

INSTITUTION OF CIVIL ENGINEERS, at 6 —Annual General Meeting.

ILLUMINATING ENGINEERING SOCIETY (at Home Office Industrial Museum, Horseferry Road), at 6 45 —G H Wilson The International Commission on Illumination and the International Congress held in the United States in 1928

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J A Speed. Flashlight in Natural History Work

QUEKETT MICROSCOPICAL CLUB, at 7 30.—Dr H A Baylis Life-histories of Parasitic Worms

ROYAL SOCIETY OF MEDICINE (Psychiatry Section) (Annual General Meeting), at 8 30 —Dr. F L Golla Some Recent Work on the Pathology of Schizophrenia —Dr W M F Robertson Gastro-intestinal Focal Infection in Relation to Oral Sepsis, with Special Reference to Anaerobes, occurring in 6 Cases of Mental Disorder.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8 30 —Dr A F Ashley-Montagu The Tarsian Hypothesis in the Descent of Man

WEDNESDAY, MAY 15

SOCIETY OF GLASS TECHNOLOGY (at University College), at 2 30 —Prof. W E S Turner The Glass Industry of North America in 1929

IRON AND STEEL INSTITUTE (in Mappin Hall, Sheffield), at 2 30 —The Hon Sir Charles Parsons and H M Duncan A New Method for the Production of Sound Steel —Third Report on Heterogeneity of Steel Ingots, by a Committee of the Institute —G A Hankins and Miss G W Ford The Mechanical and Metallurgical Properties of Spring Steels as Revealed by Laboratory Tests —L B Pfeil The Oxidation of Iron and Steel at High Temperatures —G R Bolsover Brittleness in Mild Steel —H Sutton The Influence of Pickling Operations on the Properties of Steel

ROYAL METEOROLOGICAL SOCIETY, at 5 —J E Clark, I D Margary, R Marshall, and C J P Cave Report on the Phenological Observations in the British Isles, December 1927 to November 1928 —D Brunt The Index of Refraction of Damp Air, and the Optical Determination of Lapse rate —Dr J R Ashworth The Influence of Smoke and Hot Gases from Factory Chimneys on Rainfall

ROYAL SOCIETY OF ARTS, at 8 —R Burrell The Reform of the British Patent System

EUGENICS SOCIETY (at Linnean Society), at 8

FOLK-LORE SOCIETY (at University College), at 8 —Dr M Taylor Norfolk Folk Medicine

ROYAL MICROSCOPICAL SOCIETY, at 8 —E Heron Allen and A Earland Some New Foraminifera from the South Atlantic No 1 —R. Paulson The Form of the Chromatophore of the Bright Green Gonidium common to many Lichens —D Bryce On Three Cases of Encystment among Rotifers

ROYAL SOCIETY OF MEDICINE (Tropical Diseases Section) (Annual General Meeting), at 8 15 —Prof Besredka Vaccine Therapy

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) —Annual Business Meeting

THURSDAY, MAY 16

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5 —Prof C G Darwin The Refraction and Scattering of Light (Lecture)

INSTITUTE OF PATHOLOGY AND RESEARCH (St Mary's Hospital), at 5 —Prof F T G Hobday: The Value of Research into Animal Diseases as an Aid to the Study of the Diseases of Man

INSTITUTION OF MINING AND METALLURGY (at Geological Society of London), at 5 30

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7 45 —Annual General Meeting

CHEMICAL SOCIETY, at 8 —Prof T M Lowry The Validity of Drude's Equation —A I Vogel The Dissociation Constants of Organic Acids Part I The Primary Dissociation Constants of some Alkyl Malonic Acids —Prof T M Lowry and W V Lloyd The Properties of Nicotine and its Derivatives Part I Molecular Extinction-coefficients Part II Optical Rotatory Power and Rotatory Dispersion —A I Vogel The Dissociation Constants of Organic Acids Part II The Primary Dissociation Constants of some Cyclic 1 1-dicarboxylic Acids

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W), at 8 15 —Dr V Hodson Pulmonary Tuberculosis in the Tropics, followed by a Discussion by Col S L Cummins and others

BRITISH INSTITUTE OF RADIOLOGY (Annual General Meeting), at 8 30 —Dr G W C Kaye and W Binks The Evaluation of the Pastille Dose in r Units —Dr G W C Kaye and W F Higgins An Instrument for the Rapid Visual Identification of Radium Tubes and Needles

FRIDAY, MAY 17

ROYAL SANITARY INSTITUTE (at Town Hall, Devizes), at 5 30 —R T Rhodes and others Discussion on The Milk and Dairies Order, 1926 —L B Densham and others. Discussion on Meat Inspection

ROYAL PHOTOGRAPHIC SOCIETY (Pictorial Group, Practical Meeting), at 7.

SATURDAY, MAY 18

ROYAL SANITARY INSTITUTE (at Town Hall, Devizes), at 10 A M —H R Hooper and others Discussion on Some Aspects of Local Government on Air, Water, and Sewerage —A W Jakeway and others Discussion on The Devizes Sewage Works and Small Type Refuse Destructor

PUBLIC LECTURES.

TUESDAY, MAY 14

BIRKBECK COLLEGE, at 5 30 —Lord Justice Sankey Lord Haldane's Life and the Adult Education Movement (Haldane Memorial Lecture)

IMPERIAL COLLEGE OF SCIENCE (Royal School of Mines), at 5 30 —Dr W R G Atkins The Photo electric and Photo-chemical Measurement of Light, with Biological Applications (Succeeding Lectures on May 15 and 16)

THURSDAY, MAY 16.

UNIVERSITY OF BIRMINGHAM, at 4 —Dr M B Ray The Spa Treatment of Chronic Non-tuberculous Arthritis

ROYAL SOCIETY OF ARTS, at 5 15 —Sir Norman Walker: The Progress of Dermatology over Fifty Years (Malcolm Morris Memorial Lecture)

LONDON HOSPITAL MEDICAL COLLEGE, at 5 30 —Prof J J R MacLeod The Physiology of Glycogen (Succeeding Lecture on May 17)

CONGRESSES.

MAY 15 TO MAY 20

ROYAL INSTITUTE OF PUBLIC HEALTH CONGRESS (at Zurich).

Section I —State Medicine and Municipal Social Hygiene
Section II —Industrial Hygiene and Industrial Diseases
Section III —Child Welfare, School Hygiene, and Women and Public Health
Section IV —Pathology, Bacteriology, and Biochemistry
Section V —Tuberculosis
Section VI —Climatology and Sports Hygiene
Section VII —Veterinary Medicine and Meat Hygiene

MAY 15 TO MAY 23.

WORLD POWER CONFERENCE ON COMPLETE UTILISATION OF WATER POWER RESOURCES (at Barcelona) —Subjects to be dealt with —General Hydrological Problems, Technical Problems of Water Power Utilisation, Economic and Financial Problems, Legal Problems, Protective Measures and Defence Works of Undertakings

SATURDAY, MAY 18, 1929.

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Editorial and Publishing Offices
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The Research Associations.

THE Report of the Department of Scientific and Industrial Research for the year 1927–28 (Cmd 3258) devotes considerable attention to the position, in the national economy, of the research associations set up in Great Britain under the ægis of the Department Since 1918, when the first three associations were established, some twenty-six research associations in all have been formed. Two of them, relating to the glass and cement industries respectively, have been wound up, and of the twenty-four associations still in being, one, the British Iron Manufacturers' Research Association, has not received grant aid from the Department, and its operations were suspended at the close of the first quinquennium and have not, up to the present, been resumed The British Colliery Owners' Research Association, founded in December 1924, has not received grant aid from the Department, and three other associations (Motor and Allied Manufacturers, Motor Cycle and Cycle Car, and Scottish Shale Oil) ceased to receive Government grants at the end of their first quinquennium

It will be remembered that the original scheme of the Department of Scientific and Industrial Research provided grant aid from the million fund, set aside by the Government to promote scientific and industrial research, on the basis of annual grants equivalent to the annual subscriptions of members of the associations. The scheme further provided that the grant-in-aid should be limited in each case to the first five years of the association's life. It was assumed or believed that a period of five years would be sufficient to demonstrate effectively that co-operative research was of value to industry, and that, as a result of that demonstration, the several industries that had embarked on the experiment would be willing to shoulder thereafter the whole financial burden of maintaining their respective research associations In fact, as the report of the Advisory Council to the Department states candidly, "five years proved too short a time for most of the Associations to establish their reputation by the results of their work".

There need be no surprise at this conclusion, for the first two years of an association's life are necessarily spent mostly in setting up the organisation, gathering together the appropriate scientific staff, securing the buildings and equipment, and planning a comprehensive research programme. It would be more than remarkable if, in the remaining three years, the results of any association's

work should be sufficiently striking to convince manufacturers (presumably having little or no previous experience of research applied systematically to their respective industries as a whole) that co-operative research was of such immediate and valuable service to industry that it would be a 'business proposition' for them to bear alone its necessarily high expense. St Paul may have been amenable to quick conversion, but the average British manufacturer is, shall we say, less impetuous Indeed, even now, after some ten years' experience of the work of the research associations, the report of the Advisory Council to the Department says: "It cannot be denied that most of the Associations find it difficult to get the financial support they deserve. A subscription to a Research Association is still regarded in many cases as a charitable gift, to be paid with public spirit and private reluctance, and to be withheld when funds are scarce."

At the end of the first quinquennium, therefore, the Department, looking the facts in the face, agreed to a continuance of State aid, though on a smaller scale, for a further period of five years The scale of grants was not only smaller but also, in general, it was a descending scale, calculated so that at the end of this second quinquennium the grants would sink to zero The stipulated grant-earning subscriptions were correspondingly based upon an ascending scale so that the total income of the association should remain about the same and the association be self-supporting at the end of this second period of five years But again, in fact, it was found impossible by many, probably by most, of the associations to fulfil the conditions of this carefully planned, if still heroic, scheme, and the Department, again facing the facts realistically and sympathetically, consented to modify in a more generous direction the conditions on which a number of the associations might continue to receive grants during this second quinquennium. To the associations, however, the problem remained of what was to happen to them on the termination of this second quinquennium. It was doubtful, to say the least, whether the majority of them could become financially self-supporting, on an adequate scale, immediately this second grant period ceased

Accordingly, nineteen of the research associations during the past year submitted by deputation a reasoned memorial to the Lord President of the Council, the Earl of Balfour, praying for a continuance of financial assistance by the Department on the pound for pound scale. The Lord President was unable, on behalf of the Government, to accept the proposals of the memorialists, but he announced a new policy which goes some way to meeting the difficulties with which the associations are faced. When the existing contracts for the second quinquennium come to an end, each association is to be considered on its merits and a subscription income fixed, which it will be necessary for the association to obtain from other sources before it is eligible for any grant from the Department Funds obtained from approved sources in excess of this minimum subscription income will be augmented by a grant equal in amount from the Department up to a limit depending on the circumstances of the association

That, stated briefly, is the substance of the Department's policy, in the near future, with respect to grants in aid of the research associations, and it is further evidence of the willingness of the Department, to which attention has already been directed, to modify and adapt its policy to new facts and changed circumstances The inflexible attitude of "What we have said we have said" has been wisely left to political heroes. The Advisory Council has been mindful throughout that it has a fiduciary duty to ensure, so far as it may reasonably do so, that scientific and industrial research, in close association with industrial effort, plays its essential part in national recovery

The next few years will show whether the new policy is sufficient to enable the research associations to weather the difficulties of the long period that must still ensue before the indifference and inertia, in this matter of research, of the general body of manufacturers (more particularly perhaps of those engaged in industries that have been hitherto largely run on rule of thumb) can be overcome Obviously, very much will depend, in each case, on the minimum subscription income fixed to qualify for grant. The Advisory Council states: "We do not, in any case, intend to fix it lower than an amount which, in our opinion, would be sufficient to maintain the Association in being as a useful nucleus of research. The State's contribution would then be used to assist in transforming the nucleus into a well-nourished adult and productive organisation" The associations must take hope from the biological fact that nuclei are generally small, and that it should be well within their powers to provide the funds necessary to maintain an organisation that can satisfy the Department's idea of a useful nucleus. The Department has of course a duty to the taxpayers not to put the limit too low: it has a corresponding duty to the

cause of industrial research, which its own inclination will prompt it to fulfil, not to put the limit so high as to make it prohibitive

Before or at this point the question naturally arises whether the work already done by the research associations has justified their foundation and the money expended by them On this point the Advisory Council—and it is in the best position to know—says categorically "The main purpose has, in our opinion, already been achieved Co-operative research has proved its value, it has come to stay, and we agree with the views expressed in the memorial on the importance of consolidating now the financial position of the Associations" The final report of the Balfour Committee on Industry and Trade, issued on Mar. 11, emphasises the importance of progress in scientific research and a clearer line of demarcation between the function of the State and that of industrial undertakings either singly or in co-operation In particular, the Committee urges that there should be no relaxation or curtailment of the efforts of the Department of Scientific and Industrial Research, and no withdrawal of financial support on the part of the Government.

In connexion with this last recommendation it is worth notice that the late Prof Alfred Marshall, the distinguished economist, in his "Industry and Trade", first published in 1919, specifically recommended public grants to research associations on other and perhaps unusual grounds. After pointing out that the research associations are "wholly constructive", he says: "But the experience of the ages shows that Associations set up for constructive purposes are in danger of being turned to destructive ends: and therefore it may perhaps be to the public interest that some limited contribution should be made from public funds to the support of such Associations, partly in order to facilitate the intervention of public authority in case an association should develop anti-social tendencies." The reader may find it interesting to make speculations on the character of these "anti-social tendencies" presumed to be latent in the research associations

There is a great area of British industry occupied by numerous medium-sized and small firms, directed by strongly individualistic owners, too small to enable industrial research to be prosecuted, on any adequate scale, on an individual basis Despite the modern tendency towards larger aggregations of capital by the fusion of smaller firms, it is likely that a very great field of British industry will continue for long to be represented by these medium-sized or small manufacturing units For them the only practicable scheme of industrial research, on a sufficient scale, is co-operative research, *i e.* the organised co-operation of groups of firms to provide the funds and the equipment, both personal and material, for the needed research. In this field it is most important to find for Government action the golden mean between policies of *laissez-faire* and spoon feeding.

Geometry and Relativity.

Philosophie der Raum-Zeit-Lehre Von Prof. Dr Hans Reichenbach Pp vi + 380 (Berlin und Leipzig. Walter de Gruyter und Co., 1928) 18 gold marks

THE appearance of a work on the philosophy of a branch of mathematical physics by a trained philosopher, who at the same time has a thorough knowledge of mathematical and physical methods and principles, is an event as rare as it is welcome This book by the Berlin philosopher Reichenbach, well known to mathematical physicists by his writings on relativity, is unique and should be in the library of everyone interested in geometry and relativity in their philosophical as well as mathematical and physical aspects, fully deserving a place beside the standard treatises of Bertrand Russell and Whitehead It is divided into three sections, the first on space (120 pages), the second on time (45 pages), and the third on space-time (155 pages), whilst there is an appendix (42 pages) on Weyl's extension of Riemannian geometry and the geometrical interpretation of electricity, which forms the basis of a recent paper by the same author on Einstein's new field theory of gravitation and electricity. In the brief space available here it is impossible to do full justice to the author's argument, but the following summary may be useful as an indication of the character and scope of this very important work.

In the first section the argument proceeds as follows: there is no pure intuition *a priori*, all intuition is determined by past experience. Non-Euclidean geometry is just as intuitive as Euclidean, but one must not expect to be able to imagine non-Euclidean geometry by means of Euclidean elements. Experience decides which geometry is valid in actual space, but the decision presupposes an arbitrary correspondence definition (*Zuordnungsdefinition*), which defines the unit of length in a given place and permits of a definition of congruence of lengths in different places by means

of transportable rigid measuring rods. Any geometry may be made to agree with the behaviour of actual measuring rods by postulating suitable universal forces, so that the deviations from the selected geometry are made to depend on universal deformations of the measuring rods

In the second section the author develops rather novel views. Whilst recognising the fruitfulness of the mathematical conception of space and time as a fourfold, he emphasises the point that thereby time does not lose its special character and become a fourth space dimension The comparison of times, like that of lengths, depends on an arbitrary correspondence definition, which defines simultaneity of events occurring in different places Order in time is determined by the law of causality, for the effect is later than the cause, and we can distinguish the cause from the effect, because small variations in the former produce small variations in the latter, whilst the converse is not true. The comparison of time-orders in different places depends upon the propagation of signals, and experience shows that the greatest signal velocity is that of light and is finite, so that to every instant of time at a given place there corresponds a finite interval of time at a second place, in which no instant can be connected with the first by a to-and-fro signal. Hence the given instant at the first place may be defined as simultaneous with any one instant of the corresponding time interval at the second place.

In the third section the author first discusses space-time manifolds free from gravitation, pointing out that comparison of lengths in relative motion to one another requires a new correspondence definition, which defines the length of a moving segment as the distance between simultaneous positions of its two endpoints. Experience shows that material structures, like measuring rods and clocks, conform to the relativistic and not to the classical light geometry, so that they measure 'intervals', not spaces and times. Passing on to manifolds with gravitation, the author gives the history of the idea of the relativity of motion from Leibniz to Einstein, pointing out that the very idea of motion is meaningless without a correspondence definition of rest: the relative motion of the earth and fixed stars is itself not an absolute fact, but only relative to systems of co-ordinates realisable by means of rigid bodies. He then analyses in turn Einstein's principle of equivalence and its hypothetical character, his concept of gravitation and its covariance, and his treatment of the rotation problem and idea that every system of co-ordinates requires its own gravitational field and points out the failure of some of the critics to realise that the relation of cause and effect is invariant, not covariant. This analysis of the space-time properties of gravitational fields leads the author to the important conclusion that the combined space-time order is the order scheme of causal sequences and expresses the causal structure of the world

The final discussion of the general properties of space and time begins with the characterisation of time as that dimension of the space-time manifold which determines the direction of the world lines of things distinguished by the preservation of their identity, which direction is also that of the causal sequences Then follows a discussion of the number of dimensions of the space-time manifold, ending with the conclusion that the assertion that physical space has three dimensions is on a par with the assertion that matter exists in three states of aggregation: it describes a fundamental fact of the objective world, for which no explanation has yet been found Finally, the author declares that the reality of space and time follows inevitably from his analysis of the problem.

The appendix begins with the reminder that Riemannian space presupposes congruence definitions realisable by means of rigid measuring rods and clocks, which can be displaced along different paths without violating their properties of congruence If, however, two measuring rods, congruent at the same place and time, cease to be congruent after displacement to another place by different paths, some displacement law is needed to determine the changes of length and direction due to displacement. This can be supplied by the postulate that a certain vector at one point after displacement can be identified with a second given vector at another point—this correspondence defines a displacement process and determines a displacement space (*Verschiebungsraum*), just as the usual congruence definition determines the 'metric space'

In order that the two definitions may lead to mutually consistent results, certain conditions must be imposed: we may demand that the displacement law shall have a certain symmetry and thus derive Riemannian space from the most general metric space, or that the displacement of lengths shall be integrable, that is, independent of the path, and thus derive a general Einstein's space, or we may impose both conditions and thus derive Euclidean space. The displacement process can be realised by means of rigid measuring rods and clocks, and then it determines a length displacement and a gravitational field; or it can

be realised by means of an electrically-charged mass particle, and then it determines a directional displacement and an electromagnetic field. But whilst the geometrical interpretation of gravitation given by the length displacement has led to an increase of physical knowledge in the shape of Einstein's theory of gravitation, the geometrical interpretation of electricity given by the directional displacement has not led as yet to any advance in the physical theory of electricity.

Geophysics.

Handbuch der Experimentalphysik Herausgegeben von W Wien und F Harms Unter Mitarbeit von H Lenz. Band 25 *Geophysik.* Teil 1 Unter der Redaktion von G Angenheister Pp xiv + 699 (Leipzig Akademische Verlagsgesellschaft m b H , 1928) n p

GEOPHYSICS, like astronomy, is advanced jointly by observation and theoretical discussion, and direct experimental illustration of its phenomena is rarely possible. The inclusion of this book in a 'handbook' of experimental physics is therefore slightly anomalous, but the volume is none the less welcome. Geophysics is of immense scope, because a wide variety of physical properties have to be examined as regards their distribution over the globe, and in many cases also as regards their variations over long periods of years Observation is the primary necessity, but devotion to this duty creates difficulty owing to the volume of the data accumulated The next task, scarcely less important, is to distil the essential facts from this vast material—a laborious process, involving the systematic comparison of data from many stations and, in some cases, heavy computations upon long series of observations to investigate periodic and other changes. The third and, in general, most difficult task is to bring the phenomena thus elucidated into relation with general physics , many hypotheses may have to be examined, sometimes requiring extensive mathematical developments and the extrapolation of laboratory results to extreme conditions of temperature or pressure. Frequently, the hypotheses prove totally at fault as regards order of magnitude, while in other cases judgment must be held in suspense because some of the factors involved are not yet capable of measurement

Owing to these difficulties, geophysics makes slow progress, but, as in general physics, the discovery of new fields of observation, and the advance of instrumental technique, are throwing light from new directions upon obscure problems, though also disclosing new mysteries for solution. A worker in any special branch of geophysics must, therefore, keep acquainted with the progress made in other branches, as well as with general physics. Unfortunately, there is a dearth of books summarising geophysical knowledge, and the present volume is a useful supplement to those that exist

This volume is only the first part of the geophysical section of the 'handbook' (as the series of more than twenty-five bulky tomes is curiously called) , since no indication is given of the contents of the further parts, it is impossible to judge the balance of the work, or the extent to which the ground will be covered. This first part is devoted mainly to the atmosphere, with the partial exception of the last section, on terrestrial magnetism, which may be intended to achieve the transition "from dizzy heights to solid earth" The first quarter (165 pages) of the book, by A Defant, deals with the general dynamics and statics of the atmosphere, apart from its tidal and thermal oscillations—an interesting but little-known chapter of geophysics, of which an excellent account (48 pages) is given by J. Bartels W. Milch summarises the optics of the atmosphere (44 pages), and H. Benndorf the electrical phenomena (128 pages) apart from the aurora, which is described by L Vegard (94 pages), and the penetrating radiation (K Buttner, 48 pages). Terrestrial magnetism (158 pages) is dealt with by G Angenheister and J Bartels The book concludes with good indexes of subjects and authors.

Owing to the small scale of the book in relation to the wide scope of the subject, the treatment is necessarily brief and general Its value must be judged by the extent to which it indicates the main outlines, results and problems of each section, and by the guidance to the literature which is afforded for those readers who wish to follow up any question in detail In the latter respect the book is somewhat unequal, as is natural in a collective work , in some sections the references are carried up to 1927 or even 1928, the year of publication, while in others there are few so late as 1926, though much of importance has since appeared ; a rather long interval seems to have elapsed between the preparation of some of the sections and the publication of the book.

The general treatment is good, notably so in some sections, and the book is well illustrated. Where controversial or uncertain points are touched on, the position is usually explained with proper reserve Vegard's article on auroræ is the least satisfactory in this respect, since it unduly stresses

his own theory of the auroral spectrum and the upper atmosphere. In an addendum inserted during proof-correction, McLennan's identification of the green auroral line as due to oxygen is admitted, but the remainder of Vegard's theory, postulating an atmosphere above 90 km, composed of frozen nitrogen crystals upheld electrostatically, is maintained The aurora is still very mysterious, but there are probably few physicists who would accept this solution

The conditions in the upper atmosphere are touched on in several sections of the book, Defant and Benndorf seem to favour the view that hydrogen is the main constituent above 100 km, though to the reviewer the balance of evidence seems opposed to this conclusion. On p. 3, Wegener's hypothetical substance geocoronium is mentioned, surely this speculation might by now have been allowed to lapse into oblivion, being, as it is, totally at variance with modern atomic physics and the evidence of the mass-spectrograph. The work of Lindemann and Dobson on the upper-air temperature is only briefly mentioned, though their conclusions now seem fairly established by confirmatory evidence drawn from the abnormal propagation of sound to great distances, and from the absorption of solar radiation by ozone But while in a few respects some parts of the book fall short of the thoroughness commonly attributed to German works of reference, it would be wrong to magnify minor faults in a work which as a whole has solid merits and can be recommended as a good general account of the subjects falling within its scope.

Spencer's "Sociology".

Descriptive Sociology: or Groups of Sociological Facts, Classified and Arranged. By Herbert Spencer. *Hellenistic Greeks.* Compiled and Abstracted upon the Plan organised by Herbert Spencer, by the late Sir J. P. Mahaffy and Prof. W A. Goligher (Completed by Prof. W A. Goligher.) Issued by Mr. Spencer's Trustees Pp. vi+94. (London · Williams and Norgate, Ltd., 1928.) 63*s*. net

"A LARGE book," said a Hellenistic Greek, "is a large evil." What are we to say of one the dimensions of which are nineteen and a half inches by twelve and a half? It will go into no ordinary shelf; it is awkward at best to handle, the tops of the three parallel columns of small print which fill each page are most inconveniently remote to the myopic. The physical difficulties of the format are doubtless imposed by Spencer's belief, which I do not personally share, in the utility of an elaborate chart of tabulated conclusions The book in shape and substance is drawn up according to Spencer's plan and, regarded as a monument *in piam memoriam*, it is well and truly constructed

It would of course be easy, as in all compilations of this scale, to make reviewer's points A few accents have gone wrong, there are some misprints, the bibliography does not, as the preface suggests, mention all the works from which quotation is made In the illustrative passages taken from ancient authors it might be held that for the last period too exclusive reliance has been placed upon Lucian and Plutarch Some of the moderns who are cited might be thought a little old-fashioned Did not Rostovtzeff's book appear in time for inclusion among writers on the Imperial period, and why should references be given to the second edition of Dittenberger's "Sylloge", the numbering of which has been superseded by the third? Again, one might catch some little point. for example, the belief that Prof Goligher shares with Rohde that oriental influence had something to do with the total veiling of women at Tarsus. The gloss becomes unnecessary when it is realised that what we may call severity in veiling varied in different Greek States, and that the Theban women, for example, in European Greece wore veils which permitted nothing but the eyes to be seen.

These are, however, small and some of them disputable matters. No one who has a professional interest in ancient history will refuse his meed of admiration for the wide knowledge, industry, and patience which Prof Goligher has expended on his task. At that we might leave it, were we not bound to ask whether the result justifies the very considerable labour which has gone to its achievement. Regarded as a memorial to Herbert Spencer the book might earn a favourable verdict, but regarded as a useful contribution to ancient history the answer must be less confident Clearly, it is not intended for cursive reading and will not fall easily into the category of a scholarly presentation of the subject to the general public. Of works for the specialist reader there are three useful kinds. either we expect them to contain new matter of fact or theory which is the result of original research; or, secondly, we look for the presentation of known facts in a new light; or, thirdly, we are grateful for a handy and complete compilation of facts already known. It is in the last category that the book must claim to stand, and here it must be confessed that it is vastly inferior in content as well as in convenience of format to the great dictionaries with which the

classical student of to-day is so well supplied From them information more detailed and more complete can be obtained with greater ease and, it may be added, a more structural knowledge of the problems connected with the interpretation of the evidence W R H

Preston's "Heat".

The Theory of Heat By Prof Thomas Preston. Fourth edition, edited by J. Rogerson Cotter Pp xix + 836 (London Macmillan and Co, Ltd, 1929) 25*s* net.

TO publish a fourth edition of a scientific work thirty-five years after the appearance of the first edition is a high tribute to the author, particularly when, as in this instance, no very fundamental change has been made in the scheme of the book It is the more notable in experimental science, since Preston could write in 1894 that "It is but a short time since the pursuit of experimental research was regarded merely as a matter of individual curiosity".

Whilst it is not easy to single out any one specific reason for the active survival of "The Theory of Heat", there seem to be in it several outstanding features which have combined to contribute to its continued usefulness The most essential of these is undoubtedly Preston's singularly clear and accurate style One wishes, in fact, that the first chapter, with its admirable general introduction to the subject, the seventh, on conduction, and the following one on thermodynamics—which is perhaps the best elementary account that has been written, and of which Preston is said to have been justifiably proud—could be obtained separately for examination purposes by students who have no use for the whole volume. Another reason is in the time at which Preston wrote. The epoch-making work of the end of the century on the electron had still to be done, and there can sometimes be sensed in contemporary writings the feeling that the apparent limitations of the scientific horizon were real.

Preston, whether or not he subscribed to this view, can scarcely fail to have been aware of it—he took the precaution of pointing out that "any theory, however plausible, may ultimately become untenable"—and he could thus write with greater confidence than if he had started a few years later, when he had become interested in the new physics, and was himself engaged in research on the Zeeman effect. It must also be remembered that he was dealing not only with a subject that appeared to be sound theoretically, but also that even then he had to describe experiments that aimed at, and often attained, considerable precision. Again, Preston states that he was attempting "to treat the science of heat in a comprehensive manner", and not "to meet the requirements of some particular class of persons preparing for examinations or engaged in practical pursuits", an ideal which is also realised in Tyndall's earlier "Heat a Mode of Motion" and Kayser's original pygmy "Lehrbuch der Spektralanalyse" of 1883

Mr Cotter's revision of the third edition of Preston's book is chiefly on the experimental side The square brackets which had previously marked off paragraphs which were not parts of Preston's own contribution have been removed Several condensations and omissions have been made, notably in the description of experiments and in discussions of disputed points which have now lost their interest In their places are accounts of some more modern investigations, which have been chosen with discrimination—for example, Stock's realisation of Kelvin's proposed vapour pressure thermometers, and Hercus and Laby's determination of Joule's equivalent—and there are several new references to quantum theory at the appropriate places in the text The book is naturally still far from complete, but it was never intended to be a dictionary of the subject. Mr. Cotter's task has rather been to retain the spirit and scope of the edition of 1894, but at the same time to make some necessary alterations in parts that were obviously out-of-date, and in this he has been entirely successful K. G. E.

Our Bookshelf.

Anleitung zur chemischen Gesteinsanalyse. Von Prof. Dr. J. Jakob. (*Sammlung naturwissenschaftlicher Praktika,* Band 15) Pp. vii + 81 (Berlin: Gebruder Borntraeger, 1928) 7 gold marks.

THE lack of a short but comprehensive work dealing with rock analyses has inspired Prof. Jakob to produce this book, which is intended primarily for the use of students in the laboratory. It may be placed in the hands of a beginner possessing a sound knowledge of general chemistry, and will enable him to carry out a complete analysis.

The author makes a distinction between rock and mineral analyses, each calling for a different method of treatment In a mineral analysis the object is to attain the most accurate result possible, independent of time, with a rock analysis, on the other hand, it is to produce in the shortest possible time a sufficiently accurate result to represent the specimen. Any two independent analyses carried out on the same powder show points of divergence, and this is even greater in the case of two portions of

the same rock, hence great accuracy of method is not practical and does not justify the time necessary. At the same time, however, Prof. Jakob considers that analyses should be more accurate than many quoted in the literature.

Directions are given for the preparation of the sample, fineness of grinding, etc, depending on the presence or absence of certain minerals and also on the determination to be carried out The main part of the book deals with the determination of the various oxides, a useful feature of this section being the incorporation of all explanations of processes in the form of footnotes, leaving the text free from interruptions. All analyses must be carried out only after microscopic examination, which serves as a qualitative examination this is most important, as the method used for the estimation of the sesquioxides, TiO_2 and MnO, depends on the quantity of the oxide present. The concluding section deals with rock analyses in general, in which the author discusses the characters of good and bad analyses; finally, he includes a description of the calculation of an analysis into Niggli values.

Vestiges of Pre-Metric Weights and Measures persisting in Metric-System Europe, 1926–1927. By Prof. Arthur E. Kennelly. Pp. xiii + 189 (New York: The Macmillan Co., 1928) 2 50 dollars.

As the metric system of weights and measures has now been exclusively adopted by nearly every European country, it is of some interest in connexion with proposals for its adoption by other countries to ascertain, if possible, to what extent its imposition upon the various peoples has hitherto proved effective. The most obvious means of obtaining information on this matter would appear to be the study of the periodical reports and other publications of the respective Weights and Measures Departments. Disdaining, no doubt, such armchair methods, Prof Kennelly set himself the task of collecting evidence as to the persistence of premetric vestiges by personal observation and inquiry in all the principal countries concerned This he accomplished under the auspices of the Bureau of International Research, during a sabbatical leave of absence granted him by Harvard University from July 1926 until September 1927.

That the arduous but well-ordered programme of the author was carried out with scientific zeal and discrimination is abundantly apparent, that official statements are often susceptible to enlightening amplification from other sources is demonstrated by a comparison of some of the letters received from officials and laymen, respectively, in the same locality. But the net result arrived at, namely, that where pre-metric terms persist they have practically always been 'metricised' or 'submetricised' in actual use, does not differ remarkably from the probable conclusions of any person whose pursuits entail frequent contact with administrative publications on weights and measures. Nevertheless, this is a valuable work of reference with regard to the old units, their names, equivalents, and distribution W. H. M.

Autolycus or the Future for Miscreant Youth. By Dr. R. G. Gordon. (To-day and To-morrow Series) Pp 94. (London: Kegan Paul and Co, Ltd., New York. E P. Dutton and Co, 1928.) 2*s.* 6*d.* net.

ANYONE who has acquainted himself with Dr. R. G Gordon's larger works on "Personality" and "The Neurotic Personality" will acknowledge the *a priori* likelihood of his writing a useful and authoritative pamphlet on juvenile delinquency, including the way in which society itself does much to produce its quota of pickers-up of unconsidered trifles He quotes Samuel Butler to the effect that in "Erewhon" a man who catches a disorder is punished, whereas a thief or a rick-burner is sent to a hospital, and the burden of his argument is that Butler's paradox is not so violent as it seems at first sight. We punish the child who marks the wall-paper, instead of giving him materials for the proper exercise of his artistic prowess, we punish the boy who plays football in the street, instead of providing him with a playing-field; and we assume that a girl who has been rescued from a life of infamy is best dealt with by being pitchforked into domestic service or into a public laundry. Dr. Gordon gives a simple and eminently readable account of the social, educational, psychological, and medical factors involved in the treatment of miscreant youth, and he makes a case for the calmly scientific instead of the emotional and half-revengeful methods which at present hold the field.

The Frog an Introduction to Anatomy, Histology, and Embryology. By the late Prof A. Milnes Marshall Edited by H G. Newth (Macmillan's Manuals for Students) Twelfth edition. Pp x + 182. (London Macmillan and Co, Ltd, 1928.) 6*s.*

MR NEWTH has left this work, which had not been revised since 1912, in its well-known form, but has made a number of useful alterations. He has introduced into the section on technique notes on the use of methylene blue, eosin, and formalin, and has improved the instructions on section-cutting. The suggestion that the female frog should be dissected in saline solution to prevent the great swelling of the contents of the oviducts, the instructions for making and staining a blood-smear, and for the preparation of the frog's bladder to show unstriped muscle, are helpful, and the dorsal dissection of the abdominal region of the frog, for which brief directions are given, affords the student a view of the relations of certain blood-vessels and organs from another aspect, and is useful as a revision exercise. The description of the section of the retina, of the fertilisation and early development of the frog's egg, and of mitosis and meiosis, have been amended, but here and there the editor has carried over from the old edition words not consistent with his present description, for example, the use of the term 'egg' on p. 116. The terms epiblast, etc, might now be replaced by ectoderm, etc On p. 55 the brief note on the second row of tarsal bones has been omitted

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Palæolithic Man in Ireland.

No one ever questioned the possibility that traces of palæolithic man might one day be found in Ireland, in spite of the negative results of excavations, chiefly in caves, carried out over many years by the Royal Irish Academy and the Royal Dublin Society From time to time individuals have announced their discovery of palæolithic implements, but in every case such reports were open to the gravest scientific objection. It is therefore with very special pleasure that we welcome the news contained in the accompanying statement, that the discovery has at last been made.

The work which has thus been crowned with success was carried out last August, by a party of the Bristol Spelæological Society, under the leadership of Mr E. K Tratman. It was financed by the Royal Irish Academy, and some members of that body made the local arrangements and collaborated in the excavation , but the credit of the discovery is due to Mr. Tratman and his colleagues.

A short time ago we found ourselves constrained to adopt a position adverse to a discovery of alleged palæolithic implements on the west coast of Ireland. We have never seen any reason to change our views on this matter . everything that has been written about it, and every visit which we have paid to the site, have only confirmed us in our opinion. Every possible explanation has been sought for our attitude, except the simple and obvious one that we did not, and do not, consider the 'discovery' in question to be more worthy of scientific acceptance than any of its not infrequent predecessors of the same type We have been accused of upholding preconceived prejudices in the face of evidence. We have been accused of the yet more unworthy motives of personal or national jealousy. We are therefore the more happy in being able to express our complete acceptance of the discovery here announced, and our full appreciation of its importance

J. KAYE CHARLESWORTH.
A. W. STELFOX.
R. A. S. MACALISTER.
R LLOYD PRAEGER.

EXCAVATIONS AT KILGREANY CAVE, NEAR DUNGARVAN, CO. WATERFORD, 1928.

IN the summer of 1928 excavations were carried out at this cave under the auspices of a joint committee, consisting of members of the Royal Irish Academy and the Spelæological Society of the University of Bristol The work was carried out personally by the members of the committee, assisted by students from Trinity College, Dublin, and the University of Bristol.

The excavations gave the following stratification, outside the present cave mouth.

1. Quarry debris from the roof of the former outer chamber of the cave, 0 - 2 ft.
2. Hearth number 1, of late Bronze to early Iron Age date, 2 - 4 ft.
3. A layer of brown earth and stones, with but few finds.
4. Hearth number 2. Part of a polished stone axe came from this, suggesting a very late Neolithic to early Bronze Age date. A number of human skeletons, very fragmentary, came from this level, 4 ft. - 4 ft. 6 in.
5. A stalagmite floor, divided into an upper tufaceous portion and a lower crystalline part. These were separated by a third hearth. The crystalline stalagmite was barren of remains, 4 ft 6 in. - 9 ft.
6. A layer of loosely piled stones of unknown depth, but reaching to a depth of 12 ft from the original surface. No remains from this layer.

The surface of layer 5 was intact, all over the area in which it was exposed. Before the task of excavating it was begun, special care was taken to ensure that all the upper deposits had been removed.

Leaning against a projecting piece of the wall of the cave, and originally held in position there by a pile of stones (which had become completely embedded in the stalagmite as this material accumulated), was a human skeleton, in a semi-crouched position, with the left side against the cave wall As the limbs of the skeleton were traced down, through the stalagmite, to the level of the third hearth, and as there was absolutely no evidence of there ever having been any disturbance of the stalagmite by a burial inserted from above, it is obvious that the skeleton represents a deliberate burial from the level of the third hearth ; a fact of first-class importance from the archæological and anthropological points of view · and one also that has important bearing on some of the geological problems of the late Pleistocene period.

The fauna yielded by the tufaceous part of the stalagmite was as follows · wild boar, Irish giant deer (or 'Irish elk'), reindeer, brown bear, wolf, fox, cat, stoat, hare, field mouse, Arctic lemming, birds, and land mollusca. This is a very typical Late Pleistocene fauna.

The presence of the skeleton, and the third hearth actually at the base of the deposit yielding this fauna, is conclusive proof of the presence of man in the south of Ireland in Late Pleistocene times It is unfortunate that as yet no implements have been recovered, so that we cannot yet place this Late Pleistocene man in his correct division of the Upper Palæolithic cultures.

A full illustrated account of this discovery will be published in the next issue of the *Proceedings* of the Bristol Spelæological Society, now in course of preparation.

E. K. TRATMAN.

Selection Rules in the Raman Effect.

RECENT experimental work by McLennan (NATURE, Feb 2, 1929) on liquids and by myself (*Proc. Nat Acad. Sci* , March 1929) on gases has shown definitely that transitions between vibrational levels of a non-polar molecule such as nitrogen, oxygen, or hydrogen take place in the Raman effect. I have pointed out that this, far from being inconsistent with the well-known selection rules, is exactly what we should expect to happen from the quantum-mechanical theory of dispersion.

The selection rule which works in the Raman effect can be stated as follows · in order that a shift corresponding to the transition $i \longrightarrow k$ may be observed, it is necessary that *both* states i and k combine at least with a third state l ; the Raman scattering becoming particularly intense when the energy $h\nu$ of the impinging quantum is near to $E_l - E_i$. If $E_l - E_i = h\nu$, we have fluorescence instead of a Raman effect.

The latest results I have obtained on gases, with an improved apparatus, seem to fit very well with this theoretical scheme I will give here a brief account of them.

I have extended the investigation in the ultra-violet, using the line $\lambda 2536$ of mercury, since the intensity of

the scattered radiation increases very rapidly with the frequency of the exciting light. This proved very successful, the intensity of the Raman lines scattered in gases being sufficient to record them in a large quartz Hilger spectrograph with a 60 hours' exposure. In this way a considerable improvement in resolution has been achieved, as compared with the apparatus previously used for the visible region. An iron arc spectrum has been used as a standard, and under favourable conditions Raman lines have been measured with an accuracy of a frequency unit or better. The dispersion in the λ2536 region was 131 frequency units per millimetre.

The most interesting feature of Raman spectra excited under these conditions in oxygen and nitrogen is the appearance on both sides of the line λ2536 of a number of equally spaced lines, evidently due to rotational transitions. Four or five of them can be measured fairly well

Now let us see what we should expect the rotational Raman spectrum of such a molecule to be like. Consider first the case of oxygen. Here the electronic bands to which the existence of rotational (and vibrational) Raman transitions is due (in the meaning that the upper levels of these electronic transitions play the rôle of the l state of the above-stated selection rule) are essentially the bands of the Schumann-Runge system, a $^3S \longrightarrow {}^3S$ transition. These consist only of a P- and an R-form branch, the lower (normal) electronic state possessing only odd, and the upper only even rotational states. Now consider a molecule in the lowest electronic state, and in the mth rotational state ($m=1, 3, 5 \cdots$). This state combines only with the $m-1$ and $m+1$ rotational states of the upper electronic level. The first of these combines with the m and the $m-2$ rotational states of the normal electronic level, the second with the m and $m+2$ So, on the whole, the possible Raman transitions from the m rotational states to other rotational states are: $m \longrightarrow m-2$, $m \longrightarrow m$, $m \longrightarrow m+2$. The second of them involves no change in energy—that is, gives scattered light of unmodified frequency. Of the other two, we need only consider what happens in the transitions involving a degradation in frequency ($m \longrightarrow m+2$), the others, of course, giving only anti-Stokes's lines symmetrical with respect to the exciting line.

At room temperature, the Boltzmann distribution gives an appreciable amount of molecules for values of m up to ten or fifteen.

Now, we have, for the rotational energy

$$E_m = \frac{h^2}{8\pi^2 I_0}(m+1)m,$$

so that the Raman shift (in wave numbers) is:

$$\Delta\nu = (E_{m+2} - E_m)/hc = (4m+6)h/8\pi^2 cI_0.$$

We should have a pattern of equally spaced lines, the spacing being 8 times the constant $h/8\pi^2 cI_0$. Only the first line should be spaced 10 times this constant from the exciting line.

The spacing in oxygen is too small to verify this last point, as the first three or four lines on each side overlap with the over-exposed image of the λ2536 line. But it was possible to measure fairly accurately the spacing of the lines. This gave the result $\Delta\nu = 12{\cdot}0 \pm 0{\cdot}5$ cm.$^{-1}$ Ossenbruggen finds the value $\Delta\nu = 11{\cdot}5$ cm.$^{-1}$, thus agreeing within the limits of experimental error (W. Ossenbruggen, *Zeit. f Phys.*, **49**, 167; 1928; R. S. Mulliken, *Phys. Rev.*, **32**, 186; 1928). The triplet separation of the normal state in oxygen (R. S. Mulliken, *Phys. Rev.*, **32**, 880, 1928) is much smaller (2 cm.$^{-1}$), and we do not need to take it into account.

With nitrogen I have obtained a much better plate, on which the rotational components could be measured within a few tenths of a frequency unit. I give in the following table the measured frequencies, the meaning of the calculated values being explained later:

Obs	Transition	Calc	Difference
39504 4	$12 \longrightarrow 10$	39504 6	−0 2
39489 1	$10 \longrightarrow 8$	39488 6	+0 5
39472 5	$8 \longrightarrow 6$	39472 6	−0 1
39466 6	$6 \longrightarrow 4$	39456 6	0
39412 6	Exciting line	39412 6	
39352 6	$6 \longrightarrow 8$	39352 6	0
39336 6	$8 \longrightarrow 10$	39336 6	0
39320 5	$10 \longrightarrow 12$	39320 5	−0 1
39304·4	$12 \longrightarrow 14$	39304 4	−0 2
39288 4	$14 \longrightarrow 16$	39288 4	−0 2

Here the spacing of the lines is $16{\cdot}0 \pm 0$ 1 cm^{-1}. If we assume that alternate rotational levels are missing, and that the electronic bands effective in the phenomenon—in this case the so-called $X \longrightarrow a$, $^1S \longrightarrow {}^1P$ bands (H. Sponer, *Proc Nat Acad. Sci*, **13**, 100, 1927) consist only of a P- and R-branch, we deduce for N_2 in the normal state $h/8\pi^2 cI_0 = 2{\cdot}00 \pm 0{\cdot}01$ cm^{-1}, which gives for the moment of inertia:

$$I_0 = 13{\cdot}8 \pm 0{\cdot}1 \times 10^{-40} \text{ gm cm.}^2.$$

We have, so far as I know, no data on which to check this result; but the value seems reasonable. If we had not assumed alternate levels to be missing, we should have found half this value, which is evidently too small.

The measurements in this case are accurate enough to extrapolate the position of the first rotational line. The calculated values in the table are obtained from the formula

$$\Delta\nu = 2{\cdot}00\ (4m+6), \qquad m = 0, 2, 4, \ldots$$

using for m only *even* integral numbers. As satisfactory an agreement as this could not be obtained with a slight change in the constant 2·00 and the use of odd values for m.

So, on the whole, this seems to give support to the hypothesis that in the normal state of N_2 only even rotational states are present, or, at least, they have a higher statistical weight than the odd ones. An investigation of the structure of the $X \longrightarrow a$ ultraviolet bands of N_2 would show whether these deductions are correct

Now, I think we can explain the, at first, rather puzzling fact, that the Raman lines corresponding to vibrational transitions in N_2 and O_2 (respectively 2331 cm.$^{-1}$ and 1554 cm.$^{-1}$) show no rotational structure, but, even with the higher dispersion of the quartz spectrograph, appear as single lines. We have, of course, all the allowed rotational transitions ($m \longrightarrow m+2$, $m \longrightarrow m$, $m \longrightarrow m-2$, for example, in O_2), but we must consider that each of those involving a change in m gives a *different* line; instead, when m is unchanged, the position of the line is nearly independent of m, because of the *very small* change in the constant $h/8\pi^2 I$ between the zero and the first vibrational state. So the line given by *all* the transitions $m \longrightarrow m$ has a very high statistical weight, and is practically the only one observed.

I have obtained, also, the Raman spectrum of gaseous hydrogen. It gives two lines excited by λ2536, shifted by 583 cm.$^{-1}$ and 4159 cm.$^{-1}$ respectively. These have already been found in liquid hydrogen and explained by McLennan.

I will make a last remark concerning the Raman spectrum of carbon dioxide. In a recent letter to NATURE (Feb. 9, 1929) I pointed out that the frequency observed in the Raman effect, $\nu = 1284$ cm.$^{-1}$,

is practically coincident with the difference between two frequencies observed in infra-red absorption. Now, I notice that Eucken (*Zeit. f. Phys.*, **37**, 714, 1927), in his theory of the straight-line model of the carbon dioxide molecule, assumes the existence of an 'inactive' frequency, $\nu = 1274$ cm.$^{-1}$, and the validity of the above-mentioned relation, at least to a first approximation. Thus the data on the Raman effect give strong support to Eucken's model of the carbon dioxide molecule. F. RASETTI.

California Institute of Technology,
Pasadena, California,
Mar. 15.

Floating Mercury on Water.

IN a letter in NATURE of Mar. 16, Mr. N. K. Adam describes the floating of small globules of mercury on a water surface, even when the latter was considerably contaminated. He concludes that for equilibrium to be possible, the mercury-air tension must have been reduced by the order of one or two hundred dynes. It is not necessary to suppose such a decrease. It appears that the part played by curvature of the surfaces in determining conditions for the equilibrium or the spreading of one liquid on another has been neglected. Experimentally, we have the observations of Burdon (*Proc. Roy Soc*, **38**, 2, 154; 1926), who found that water would spread over the surface of a large, clean mercury drop, but that its progress was stopped when the curved edge of the drop was reached, where acceleration 'downhill' would be expected.

The familiar criterion for spreading is derived, sometimes from the consideration of the three 'tensions' involved and the possibility of constructing a Neumann triangle, but more often from the point of view of surface energy. Spreading will occur if the advance of the liquid brings about a decrease in the total surface energy. Let T_1, T_2, T_{12} be the tensions involved, and let the increase in area when the liquid 1 advances a small distance A to B be S (Fig. 1*a*). The increase in energy is then $T_1S + T_{12}S$ and the decrease is T_2S. Then for spreading, $T_2S > T_1S + T_{12}S$ or

$$T_2 > T_1 + T_{12}. \quad (1)$$

But suppose now that the surface of the lower liquid 2 is curved, as in Fig. 1*b*. Here the decrease in energy

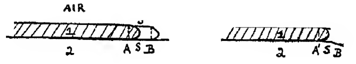

FIG 1

is still T_2S, but the increase is now $T_1S' + T_{12}S$—where S', the increase in area of the liquid-air surface of 1 is *not necessarily equal to S* Then the condition for spreading becomes

$$T_2 > T_{12} + T_1\frac{S'}{S}. \quad (2)$$

If S' is greater than S, it is quite possible that even if condition (1) is fulfilled, that is, spreading occurs on a plane surface, (2) is not; spreading is stopped by the curvature.

Using the figures given by Mr. N. K. Adam for the uncontaminated liquids, spreading would be stopped if the ratio S'/S were greater than $1 \cdot 4 : 1$, so that spreading may have been stopped by the curvature (0·5 mm. diameter) without the considerable lowering of the tension stated.

Yet for the curved surface as for the plane, the condition that the Neumann triangle cannot be drawn is still (1), and from the point of view of the equilibrium of tangential forces at the interfaces, it is difficult to see how curvature can enter into the problem. It seems to me that this is another indication of the many that the conception of three tangential forces at a point—and of Neumann's triangle—is wholly inadequate to represent the forces involved in capillary phenomena.

It may be noted that in Coghill's work on lenses of oil floating in water (*Tech. Paper* 262, Bureau of Mines, Washington, 1923) the measured interfacial angles did not agree with those calculated from the Neumann triangle.

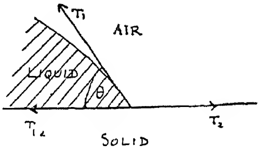

FIG 2

It must have been often remarked that in the case of a liquid in contact with a solid, for example, the three tensions alone are, to any student of elementary mechanics, not in equilibrium, though few text-books mention that other forces have been omitted or explain what these forces are. If the 'tensions' do not give an adequate representation here, why can we assume that they are sufficient in other problems? Theoretically unsound, the Neumann triangle has no experimental usefulness—and the 'spreading coefficient' used by Hardy and Harkins is limited in its application to plane surfaces.

C. A C. BURTON.

University of Toronto,
April 5.

IN a letter appearing in NATURE for Mar. 16, Mr. N. K. Adam describes floating mercury droplets. These droplets are minute (0·5 mm. in diameter), and Mr. Adam evidently regards them as fluid throughout supported by the surface tension of the water.

In a letter to NATURE for July 2, 1903, p. 199, I described the production of mercury bubbles floating on water. These might be any size up to 2 cm in diameter, and were supported not by surface tension but by flotation, as might be seen from the fact that they floated even when the water-film was continuous over them. Measurements of the weights of mercury forming these bubbles and estimations of the thicknesses of their skins were given.

HENRY H. DIXON.

School of Botany,
Trinity College, Dublin, Mar. 17.

Hibernation of *Lucilia sericata*, Mg.

SINCE the hibernation of the Muscidæ affords such general interest, it is felt that recent observations on this phenomenon as exhibited in the particular species *Lucilia sericata*—the most important entomological pest of sheep in North Wales—are worthy of note

It should be explained that my interest in the hibernation of *Lucilia sericata* arose as a result of a survey of 'Maggot Flies' attacking sheep in North Wales in 1928, which showed that *sericata* was the only species concerned.

All larvæ used during these observations were taken by farmers direct from infested sheep. When received, at almost daily intervals throughout the season, they were placed in the insectary in cages containing a piece of fresh meat on soil. From May 5 until Sept. 8, the period which elapsed between the receipt of the larvæ at the laboratory and the date of emergence was fairly constant—on the average 21 days. The majority of the larvæ received on Sept. 8 and 10, however, had not pupated by Oct. 10. Instead, many remained quiescent in the soil at the bottom of the cages, while

others had entered empty pupa cases. Further, it was noted that not a single larva of the ten subsequent batches—the final batch being received on Oct. 27—had pupated.

On Oct. 15, 720 such larvæ, received from various sources, were available for hibernation observations and were used in the following experiments. Six earthenware pots, 5 inches deep, were filled with soil and closed above with muslin; four represented arable conditions, while two had turf placed on top of the soil to create a grassland environment. One of the 'grassland' pots and two of the 'arable' pots were placed in the laboratory, while the duplicates were sunk in the soil out-of-doors, the rims of the pots being at ground level. 120 larvæ were allowed to drop on to the surface in each of the pots, all had burrowed out of sight in about 15 minutes A week later larvæ were found at the bottom of each pot.

Periodic examination of the out-of-door pots showed that the larvæ remained thus buried and in a quiescent state throughout the winter, the mean daily temperatures (taken just above the pots) for the months concerned being: Oct, 59·85° F, Nov., 51·09° F., Dec, 43·58° F.; Jan, 41·77° F., Feb, 43·76° F, Mar, 52 98° F.; April, 57 3° F.

On Feb. 14, with a minimum temperature of 16° F., the soil was completely frozen, yet the quiescent larvæ when disturbed proved to be viable. No activity was observed in the pots until the period Mar. 20–26 (mean daily temperature, 53 86° F.), when it was noticed that the larvæ were making their way towards the surface. They eventually came to rest at a level approximately ¼ in. below the surface. On April 2 the first pupa was found, and by April 10 the majority of the larvæ had pupated. The first fly emerged out-of-doors on April 27.

Observations on the indoor series gave similar data, except that the flies emerged at an earlier date; the first being found on April 10. The mean temperature throughout the winter was more or less constant at 51° F (since the last week in March it has risen about 9°). The humidity was maintained by daily watering of the pots

The hibernation of *Lucilia sericata* has not, so far as I am aware, formed the special study of a previous worker. Mention is made in some works of the difficulty experienced in getting the larvæ to pupate in the autumn, but there is no suggestion that the insect overwinters in the larval stage Records from S. Africa and New South Wales show that adults have been trapped throughout the year, while in the United States research has indicated that *sericata* overwinters in the larval and pupal stages.

From the observations here mentioned it would appear that the normal mode of hibernation of *Lucilia sericata* in North Wales is in the larval stage. Further, while the return of the larvæ to the surface after overwintering and prior to pupation obviously facilitates emergence, it should be pointed out that at this time they are more open to control methods than at any other stage after leaving their host.

W. MALDWYN DAVIES,
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University College of North Wales,
Bangor.

Cosmic Radiation and Radioactive Disintegration.

DR. L. R. MAXWELL, in NATURE of Dec. 29, 1928, gives an account of experiments intended to show the influence of cosmic rays on the speed of radioactive disintegration of polonium. According to Perrin, the radiation may be regarded as a possible cause of radioactive changes. The detailed study of cosmic rays, carried out lately by numerous investigators, and the determination of their probable wavelengths, combined with the ideas of Perrin, involuntarily led us to think that the cosmic rays may be the real cause of radioactive processes. The frequency of cosmic rays is of such magnitude that their quanta ought to be sufficient to disintegrate the nucleus.

At our request, Mr. E. Halfin, in June of 1926, performed some experiments with radon analogous to those of Dr. Maxwell. The activity of two nearly equal quantities of radon was carefully measured, and thus the exact value for the ratio of the activities of two chosen samples was obtained. Immediately after, one sample was let down to the bottom of the Gulf of Finland to a depth of about 20 feet and the other sample was left in the laboratory. After several days the first sample was taken out, and the comparison of the activities of two samples was repeated in the laboratory. These experiments have shown that, within the limits of possible errors, the speed of disintegration of the sample of radon which was kept under the water did not appreciably change. The error of the corresponding measurements in any case did not exceed 1 per cent. Our experiments with radon and Dr. Maxwell's experiments with polonium show that the cosmic rays do not affect in appreciable degree the speed of disintegration of either radon or polonium. These facts lead us to the conclusion that the disintegration of the two elements investigated is not, at least entirely, due to the action of cosmic rays.

It would not be correct though, on this ground, to deny any influence of the rays on radioactive processes. As a matter of fact, the total intensity of the cosmic radiation is so small that it is quite possible that it affects in some way a very minute number of radioactive atoms, and its action cannot be detected, especially in the cases of radioactive atoms of short life.

The cosmic rays, furthermore, may perhaps give a start to the disintegration process in the radioactive family and actually cause the disintegration of the first element in the family, for example, uranium. Experiments with this element (observation of the growth of activity of uranium X_1) might throw some light on the last question. In this case the total intensity of cosmic rays might be sufficient to account for the radioactive process, as the number of atoms of uranium which disintegrate in unit time is very small.

N. DOBRONRAVOV.
P. LUKIRSKY.
V. PAVLOV.
Leningrad.

The Structure of the CH_4 Molecule.

IN a recent investigation of the ionisation processes in methane, Hogness and Kvalnes (*Phys. Rev.*, **32**, December 1928), using a mass-spectrograph method, find that at 14·5 volts only CH_4^+ ions are formed, but at 15·5 volts two processes occur; either stable CH_4^+ ions are formed or unstable CH_4^+ ions which dissociate spontaneously into CH_3^+ ions and neutral hydrogen atoms, the probabilities of the processes occurring being approximately equal over a wide range of pressure.

Two models have been proposed for the CH_4 molecule, one having a C^{4-} central ion of neon-like character, the other having a C^{4+} central ion, but neither of these models will explain the results quoted above. If the four chemical bonds in methane consist of pairs of shared electrons, each pair being formed by an L electron of the carbon atom and a hydrogen

electron, then a simple explanation can be given, for since there are two 2_1 and two 2_2 electrons in the carbon atom, two of the bonds will differ from the other two, that is, two of the pairs of electrons will be differently bound from the other two. Two ionisation potentials would therefore be expected having approximately equal probabilities of excitation. This assumes that the ionisation potential of either of the two electrons forming a bond is the same. That two of the bonds in methane differ from the other two is in agreement with Mrs Lonsdale's view that the carbon atom has two different kinds of valencies (*Phil. Mag.*, **6**, p. 433, 1928), and is also supported to some extent by the observation of Cabannes and Gauzit (*Jour. de Phys.*, **6**, p. 182, 1925), that methane has a small depolarisation factor, an indication of small optical anisotropy. Experimental evidence also tends to show that models of the methane molecule having either a C^{4-} or a C^{4+} central ion are incorrect (cf. T H. Havelock, *Phil. Mag*, **3**, p 444, 1927; **4**, p. 721; 1927)

G. W BRINDLEY.

Physical Laboratories,
University of Leeds,
April 26.

The Constitution of Oxygen.

DR. F. W. ASTON has remarked (NATURE, **123**, 488; Mar. 30, 1929) that he finds no positive ray evidence for the existence of isotopes of oxygen, and he states that if O^{18} exists, as concluded by Giauque and Johnston (NATURE, **123**, 318; Mar 2, 1929), it must be in a proportion less than 1/1000 of O^{16}.

Giauque and Johnston based their result on data published by Dr Dieke and myself (*Proc. Nat. Acad. Sci.*, **13**, 670; 1927). Further evidence bearing on the question has now been found, confirming the existence of O^{18}, and also the limiting proportion set by Aston. From spectrograms made with low solar altitude it has been possible to augment the *A'* band of oxygen from 26 lines, as formerly described, to 73 lines. About one-half of these belong to the alternate system of doublets which are to be expected from the unsymmetrical molecule O^{16}–O^{18}, while the rest of the new lines are extensions of the previously recognised system of doubtlets. The observed positions of the lines of this band agree with those calculated for the isotopic molecule, and the new data thus decisively confirm the existence of O^{18}.

Intensities of the isotopic band lines have been compared with those of homologous lines in the *A* band by so choosing the lengths of air-path as to make the two bands appear alike when registered with the same spectrograph. From the ratio of the air-paths it was found that the *A* band is 1250 times as intense as the *A'* band, and, approximately at least, this represents the relative abundance of the molecules O^{16}–O^{16} and O^{16}–O^{18}. More complete discussion will be found in a forthcoming paper in the *Proceedings of the National Academy of Sciences.*

HAROLD D BABCOCK.

Mount Wilson Observatory,
Pasadena, California,
April 15.

Selective Absorption by Excited Mercury Vapour.

OUR attention has been directed to a paper by M. M. Ponte on the selective absorption by excited mercury vapour (*Comptes rendus*, **187**, 37-39, July 2, 1928) giving results of photometric measurements on the prominent lines in the arc spectrum of mercury. M Ponte refers to a paper by us on the same subject (*Proc Roy Soc.*, A, **100**, p 149, 1921), but does not notice a paper by Turner and Compton (*Phys. Rev.*, **25**, 606-612; 1925). He finds that the absorption diminishes as the current term number of the line in a series exhibiting absorption increases; a similar result has been recorded by Turner and Compton (loc. cit).

In the latter part of his paper, M. Ponte records his observation of the reversal of the green line and six of its satellites and of 4358, but not of the two yellow lines. In this connexion we have to point out that in a paper published by us in 1924 (*Proc. Roy. Soc.*, A, **105**, 520-531), not referred to M. Ponte, we have described, among others, experiments proving the reversal of the green line and all its satellites except one, namely, − 0 237, of the line 4358 and four of its satellites, of the two yellow lines, and two of the satellites of 5769, namely, + 0 044 and − 0 050 The device of using the broadened lines from a high pressure source as a background for the formation of the reversal lines produced by an absorbing column at low pressure suggested by M. Ponte has been mentioned by us in the same paper. M. Ponte's method of exciting the absorbing column by maintained high frequency oscillations is of special interest.

E P. METCALFE.
B. VENKATESACHAR.

Central College,
University of Mysore,
Bangalore, India, April 3.

Raman Effect in Atomic Hydrogen.

IN the paper on the dispersion of hydrogen-like atoms published in the *Proc. Nat. Acad. of Sci.*, **14**, 253 (1928), I have obtained a solution of the Schrodinger wave equation, for a hydrogen atom in the field of radiation of frequency ν, of the form

$$\psi = e^{2\pi i Et/h}[\psi_0 + e^{2\pi i\nu t}u_1 - e^{-2\pi i\nu t}u_2],$$

where ψ_0 is the solution of the unperturbed equation, while u_1 and u_2 are small quantities which are functions of co-ordinates only.

The Raman effect for atomic hydrogen comes out of this solution naturally. If one calculates the matrix elements corresponding to components of the electric dipole moment, one obtains terms containing factors exp $2\pi i(\nu - \nu_1)t$, exp $2\pi i(\nu + \nu_1)t$, and exp $2\pi i\nu_1 t$ respectively, where ν_1 is the frequency of absorption lines. In addition to the ordinary transitions, the transitions with a change of azimuthal quantum number by ± 2 are now permitted. Details of the investigation will be published elsewhere.

BORIS PODOLSKY,
(National Research Fellow).

University of California,
Berkeley, California,
April 15

Ozone Absorption during Long Arctic Night.

A LETTER from Prof. R W. Wood on this problem (NATURE, April 27, p. 644) calls for some comment. Prof. Wood's contention that my observations of ozone absorption in December last (cf. NATURE, Feb. 9, p. 207) are not decisive because the atmosphere above my station was sunlit at noon, overlooks the important fact that *this sunlight had all been filtered through the atmosphere, and at grazing incidence, such as to have its activating constituents effectively removed.* On account of the crude equipment the results are, however, provisional in nature, and this and allied problems will therefore be pursued next winter with an improved telescope

S. ROSSELAND.

University Observatory,
Oslo, April 29.

Iron Manufacture and Heat Generation.[1]

By Prof. HENRY LOUIS.

THE date and even the place of the first use of iron by mankind have never been determined, it appears to be generally held that iron was first produced in workable quantity on the southern flanks of the Caucasus, and the date assigned is usually somewhere about 3000 B.C, though for my purpose both the place and the exact or even the approximate date are matters of secondary importance. My main object is to indicate that the history of iron manufacture shows it in the light of a consequence of the ever-increasing power which mankind gradually learnt to exercise over the production of heat, and I hope to be able to show that the history of iron and the history of heat generation have gone hand-in-hand throughout the ages, and that the former has been absolutely dependent upon the latter. It is certain that, before iron came into use, the metallurgy of bronze was already highly developed Articles of bronze of the Later Bronze Age show that the art of bronze-founding had already reached a high stage of perfection. The art of making cored castings was undoubtedly known, and it seems probable that even the *cire perdue* process had been invented

No doubt the simple reduction of metallic iron from its ores would have been well within the capabilities of these primitive metallurgists, but from the simple reduction of the metal to its fashioning into any useful form is quite a far step Oxide of iron is reducible to the metallic state at a very low temperature, not exceeding 500° C, but the iron so produced is more or less pulverulent and useless for all practical purposes To weld it into

FIG. 1—Blowing up the fire by the mouth blowpipe (Egypt). From Wilkinson's "The Ancient Egyptians".

a coherent mass capable of useful application requires not only a considerably higher temperature, but also for articles of any size a considerable body of heat, and this would apply equally to the forging of meteoric iron. The only information that we have as to the early means of producing the necessary heat is derived from Egyptian mural paintings. All the earlier ones—for example, one from the frescoes of Beni-Hassan (Fig. 1), said to date from about

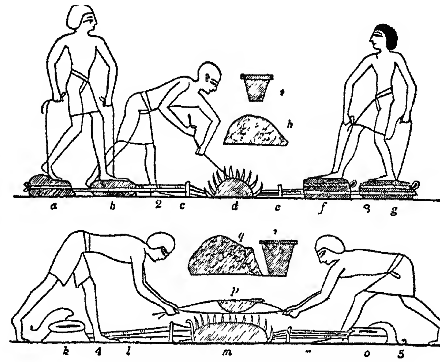

FIG 2—The earliest known form of bellows (Egypt). From Wilkinson's "The Ancient Egyptians"

a, b, k, o, the leather case
c, e, l, n, the pipes conveying the wind to the fire
d, m, the fire
h, q, charcoal
k and *o* are raised as if full of air

2500 B C—show men blowing up a fire beneath a crucible by means of mouth blowpipes made of reed and tipped with clay, and it is evident that with such rudimentary appliances only very small pieces of iron could be produced

The first known representation of any mechanical means for producing a blast is from the walls of a tomb of the period of Thothmes III, supposed to be from about 1500 B C This primitive bellows (Fig 2) apparently consists of a flat pot covered with skin, in the centre of which is cut a hole that can be closed at will by the heel of the operator, which thus forms a valve, the skin, when released by the heel, being pulled up by a cord in the worker's hand. It is interesting to note that this identical type of bellows is still used in India by certain tribes for the purpose of iron manufacture, the only improvement in more than 3000 years being the use of a couple of light bamboos which act as springs to pull up the hide cover A photograph of a native lad working these bellows (Fig. 3), taken a few years ago by the late Mr Seymour Wood, shows the method, moreover, these bellows have been figured in full detail by Dr. John Percy in his classical work on the "Metallurgy of Iron and Steel"

The position at a tolerably reliable date can be well estimated from the British Museum excavations at Djerabis on the Euphrates (the Charchemish of Biblical times), as recorded in Biblical writings, this place was attacked and captured by Nabuchadnosor, King of the Babylonians, in 604 B C The finds consisted of broken swords and spear-heads, all of bronze, and of numerous arrow-heads, both of bronze and of iron; there was also found a beautifully finished bronze mould

[1] From the presidential address delivered to the Iron and Steel Institute on May 2.

for casting the bronze arrow-heads, and it is particularly noteworthy that these bronze arrow-heads are far superior in execution and finish to the iron ones—the iron ones being all tanged, whilst most of the bronze arrow-heads are socketed

It is therefore evident that at this date, even in the centre of the highest civilisation of the time, skill in working iron had not reached anything like so high a level as that of the bronze-worker, the finds are, of course, not conclusive evidence that no larger weapons of iron were in use at the time, but I think that the conclusion may fairly be drawn that they must have been far scarcer than the bronze weapons, and that the difficulty of working even moderately large pieces of iron had by no means been fully overcome, and that whilst small articles of iron could be made readily enough, there must still have been difficulty in producing the larger articles which required a considerable body of heat This emphasises the essential point which I want to bring out, that the means of generating the requisite heat must have been the controlling condition in the manufacture of iron Furthermore, as is well known, whilst iron reduced at a low temperature, even from impure ores, is sufficiently pure not to be brittle, it must necessarily be very soft, and it may readily be supposed that a well-made bronze sword was for quite a while superior to a soft-iron one. This difficulty must have persisted until a much later date in northern Europe, since the Norwegian sagas more than once record that a warrior had a sword so soft that he had to stop to straighten it underfoot in the course of the conflict.

On the other hand, it is quite certain that in the countries bordering on the Mediterranean, where the knowledge of metallurgy was much older and civilisation was much further advanced, temperatures high enough to cause some carbon to combine with the iron and thus make relatively low carbon steel or steely iron had been attained at a very much earlier date, as is evident from the oft-quoted passage in Homer's Odyssey, from this it is obvious that steel or steely iron capable of being hardened by quenching was known in Homer's time, though the carbon content could not have been excessive, seeing that the metal so treated was not too brittle to prevent its being used as an axe, yet there must have been enough carbon present to cause perceptible hardening by quenching, seeing that Homer states that such quenching gives strength to the iron On the other hand, Homer's frequently repeated epithet for iron "wrought with much toil" shows that the manufacture of iron was still in an elementary stage, it will be remembered that Homer certainly wrote before 800 B C

It could, however, not have been very long after the beginning of our era before, with the employment of larger furnaces and, therefore, the production of a greater body of heat, a true steel was produced, and this would, of course, be the case more readily when manganiferous ores happened to be employed instead of ordinary iron ores. Thus both Horace and Ovid refer in their poems to the high quality of Noric iron The Noric kingdom corresponded to the region now known as Styria and Carinthia, and it is quite probable that this Noric iron was made from manganiferous spathic iron ores of the Styrian Erzberg of Eisenerz Jars, who visited the Erzberg in 1758, directs attention to the fact that steel was readily produced by smelting certain of these ores Similar ores appear also to have been worked in Spain, and they, too, must have produced steel or steely iron, and we have evidence that some at any rate of this material consisted of iron combined with sufficient carbon to be capable of being appreciably hardened by quenching It must be remembered that the above statements as to the use of iron refer only to the region which at that early date was the centre of human civilisation, it is generally held that iron was not introduced into Britain until 500 B C, and that its manufacture did not commence in these islands until about a century later

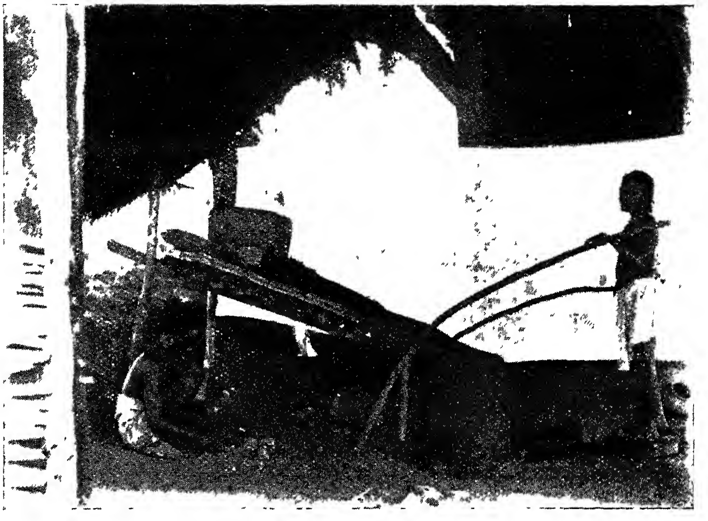

FIG 3 —Bellows as used in India.

Before Cæsar's invasion, iron was certainly being made in the south of England, though the Brigantes in the north appear still to have been in a Stone Age Before Cæsar's time, iron currency bars were in use in southern Britain—a fact which would seem to imply that, although iron was being made, it was still scarce and comparatively valuable The manufacture of iron continued in Britain throughout the Roman occupation The largest

mass of Roman iron found in Britain, if not in the world, is the mass discovered at Corstopitum, near Corbridge, in Northumberland, described by Sir Hugh Bell. Its date is considered to be between A.D. 350 and 380, and its weight was about 3 cwt. It is quite clear that the method of iron production throughout all this period was always the same—namely, direct reduction by charcoal in furnaces probably not more than 3 ft. or 4 ft. high, and blown by bellows worked by man-power, in which the temperature was only high enough to produce soft malleable iron, or, at the best, with suitable ores a steely iron or a steel. Apparently this method of iron-making must have continued during the next thousand years or so, probably furnaces were steadily increasing in size, larger lumps of iron were being made, and probably steely iron or even steel was produced at will The art of letting down or tempering steel must also have been discovered, and the technique of iron working, as distinct from the extraction of iron, made immense strides

An invention that must have contributed no little to the increase in the size and power of the medieval furnace was that of mechanical blast production Agricola, whose well-known work is dated 1556, figures and describes in much detail the construction of a bellows with valves of quite modern type, worked by a water-wheel, and it is on record that such bellows were in use at Gollnicz in 1435 A natural result of the increase in the height and power of the furnace and of the attendant higher heats thus generated was the production of white cast iron, and it is tolerably clear from Agricola's writings that this was known in his day No doubt this unexpected result of the higher furnace temperature must have been a disagreeable surprise to the early metallurgist, who found in his furnace a lump of this hard, brittle, useless material instead of the mass of malleable iron or steel which he hoped to produce. In the course of time, however, he would discover that this useless metal could have its pristine malleability restored to it, or, as he expressed it, the iron could be 'freshened' by heating it in another (or possibly the same) furnace. When this technical stage had been reached, the iron-worker no doubt soon learnt to appreciate the advantage of a continuous process in which the metal could be made to flow out from his reduction furnace, over a discontinuous process in which the lump of metal had to be dragged out of the furnace either by tearing down the furnace front or by lifting the lump bodily out of it This step would lead to a still further increase in furnace and bellows capacity, and this in turn would bring about a further increase in furnace temperatures, with the again unexpected result of producing grey cast iron, as soon as the temperature became high enough to reduce sufficient silicon It would soon be found that such iron ran very fluid and was admirably adapted for making castings.

Apparently one of the very earliest forms of iron castings was the iron stove plate, which originated in Germany The oldest known cast-iron stove plate is dated 1497 and was from the Eifel, which appears to have been one of the earliest centres at which castings of this kind were made No doubt it took the early founders some time before they learnt to adapt their bronze-founding technique to this new material, very much in the same way as in our own time iron-founders have had to learn to modify their methods for the successful production of steel castings, but the superior qualities of articles made of cast iron would be a sufficient incentive to urge these early workers to find out how to overcome their difficulties Once this was done, a demand for such pig iron would arise and the blast-furnace making charcoal iron was evolved The next step was the substitution of coke for charcoal, thus attaining the production of still higher temperatures, it is, by the way, interesting to note that the first coke furnaces still used bellows worked by a water-wheel, just as in Agricola's time, and that these continued in use up to the middle of the eighteenth century. About that date they were, however, replaced by iron blowing cylinders, capable of generating a more powerful blast, and, therefore, of producing higher temperatures, whilst Neilson's invention of the hot-blast in the year 1828 enabled still higher temperatures to be attained in the blast-furnace.

The next stage was the production of mild steel in the Bessemer converter and the Siemens open-hearth furnace, to be followed by the important modification of Thomas and Gilchrist, which we know as the basic process. Necessarily, these processes involved the use of still higher temperatures than had hitherto been attained, and finally we reach the production of alloy steels in the electric furnace with its capacity for generating still higher temperatures

I do not wish to imply that each one of these successive stages immediately and definitely put an end to all use of the earlier processes Quite the contrary is the case, for there are many examples of the old and new methods working side by side Even to-day in India and in many other similar countries the direct process is still in use. Again, although Abraham Darby successfully made pig iron with mineral fuel so far back as the year 1735, charcoal blast-furnaces are still in operation in Sweden and various other parts of the world, and there was even one still at work in Great Britain at Backbarrow, near Ulverston, until Dec. 17, 1925. In spite, however, of this overlapping of processes and of the survival of the older methods alongside of newer ones, the line of progress is quite unmistakably defined

It will, I hope, be admitted that this rapid review of the history of iron manufacture is correct, at any rate, in its main features, and that my contention that the power to produce high heats has throughout been the controlling factor, is well founded; I want to make it clear that I consider that the various stages of iron manufacture and of the generation of ever higher temperatures are not two independent concurrent parallel lines along which the development of human civilisation has

travelled, but that they are distinctly related as cause and effect. This being true of the past, what can we say as to the future? Just as there is a lower heat limit below which iron capable of being usefully applied in the arts could not be produced, so there must be an upper limit, and I suggest that this limit is reached when our furnaces are capable of generating a temperature sufficient to volatilise the iron; it seems fairly obvious that heats higher than this cannot well be usefully employed. Such heats are, however, now readily attained in the electric furnace, and it would therefore seem that from this point of view the limiting condition has already been reached by the metallurgist On the other hand, there seems but little inducement to increase the quantity of output, seeing that our potentialities of production appear to be now actually ahead of the world's requirements, and that there is every indication that even our present appliances will enable us to keep pace with any future demands.

I emphatically do not mean to imply that we have reached finality in the metallurgy of iron, but I do hold that future progress will have to be along different lines. Fortunately, we are already able to see what direction this progress must take. Recent advances have all been in the direction of improvement in quality and in the attainment of properties in which ordinary iron by itself is deficient. In other words, the future of the metallurgy of our metal will be directed, not by the crude methods of trial and error of the past, but by the application of principles developed by the methods of scientific research For something like four centuries Great Britain has led the way in the great improvements in the iron industry along the old lines which I have been describing; we are, however, also the inventors of the science of metallography and of alloy steel, we may, therefore, fairly claim that even in modern scientific methods we are equally leading the world in the metallurgy of iron, and there is every reason to presume that the great work which members of the Iron and Steel Institute have done in the past in developing that iron industry which is the basis of our modern civilisation will still continue in the future, although, as I have suggested, that work will be carried on by means of modern methods and be based upon entirely different principles

Progress of the Great Barrier Reef Expedition.

By Dr C. M. YONGE, Balfour Student, University of Cambridge

IN the three months which have elapsed since the last report, the work of the Great Barrier Reef Expedition, in all its branches, has made excellent progress Naturally, the weather conditions have not been so favourable as they were in the winter; heavy rains and humid heat, with wet bulb readings so high as 86° F., have been experienced, but work has been interfered with far less than was anticipated The most serious drawback has been the state of the tides, the day low tides being very poor, which necessitated much collecting by night On the other hand, sea work has proceeded without a hitch in spite of the previous gloomy accounts of the storminess of the summer months.

A great loss has been experienced in the departure from Low Island on Dec. 12 of Mr. and Mrs. F. S. Russell and Mr. G. Tandy, who were compelled, owing to the termination of their leave of absence, to return to England. Dr. T. A Stephenson has succeeded Mr. Russell as second in command, while Mr. A P. Orr has taken over charge of the boat party, Mr J. S. Colman carrying on Mr Russell's work on zooplankton There is, unfortunately, no professional botanist to succeed Mr Tandy, though Miss Glynne is expected for two months later in the year; meanwhile Mrs. Stephenson is doing what she can to continue the collection of algæ Mr. M. Spender, of the geographical section, is now with us permanently, while Miss E. A. Fraser, of University College, London, and Dr. S. M Manton, of Cambridge, join us shortly. Both will work in co-operation with the reef party under Dr Stephenson

The regular plankton and hydrographic observations at the station 3 miles east of Low Island have been continued with scarcely an interruption; a further station has been worked in Trinity Opening, all from the *Luana*; while on two occasions the powerful motor launch *Merinda* has been hired from Cairns for work beyond the Barrier. For the hauling in of nets and hydrographic gear from deep water a friction winch with a small motor has been purchased, and this renders work both easy and relatively speedy.

At the inside station Mr. Orr reports that temperature has risen steadily to 29° C. at the surface and 28·8° C. in deeper water, while salinity has fallen and continues to fall as a result of the heavy rains. On several occasions there has been a definite gradient in temperature and salinity, accompanied by a fall in oxygen saturation in the deepest layers, though without any production of phosphate, but this has never lasted more than a week at a time or ever been considerable enough to withstand a wind of more than 20 miles per hour The hydrogen ion concentration has remained steady throughout Observations made at a depth of 600 metres beyond the Barrier showed that temperature was constant down to 50 metres, beyond which it fell rapidly to 10·9° C. at 600 metres. Below 50 metres, *p*H value and oxygen saturation sank and phosphate content rose. On Linden Bank, a coral formation beyond the Barrier and covered with 34 metres of water, the conditions were very similar to those inside the Barrier. The turbidity of the water is far less beyond than within the Barrier.

Miss S. M Marshall and Mr. Colman are continuing routine work on the phytoplankton and zooplankton respectively. As the lack of nutrient salts in the water indicates, there has been no

significant change in the numbers of the phytoplankton within the Barrier, while the numbers have been found even smaller in the open sea stations, there being little difference in type save for a few oceanic flagellates rarely found inside The only notable change observed in the zooplankton occurred during the three weeks at the end of November and the beginning of December, when spatangid plutei appeared quite suddenly in vast numbers, the coarse silk townet catching just under 300,000 in a half-hour haul It may be noted that dredging has revealed the presence of great numbers of a species of *Lovenia* in the mud around Low Island, one haul of the Agassiz trawl bringing in a catch estimated at about 20,000 Salps and Larvacea continue to fluctuate in an apparently irregular manner, and also copepods, which usually comprise numerically more than half the catch On one occasion when planulæ were being extruded from *Pocillopora* on Low Island, some 3000 similar planulæ were caught in the coarse silk net Again, on another occasion the numbers of *Cavolinia* rose from an average of less than 50 to 1200

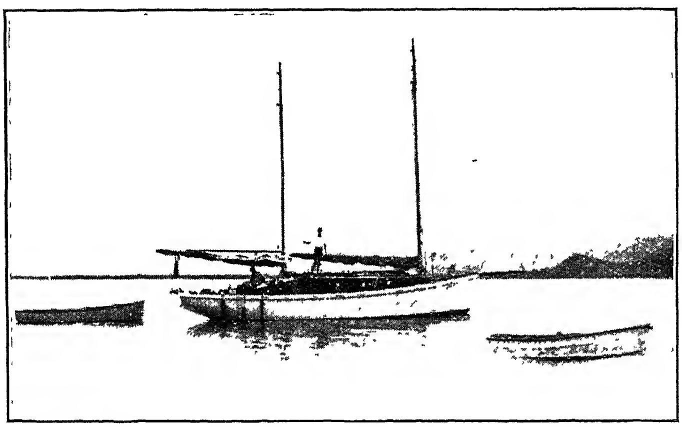

FIG 1 —The *Luana* at anchor between Snapper Island and the mainland

Work over the reef flat by members of the boat party has been continued. Mr Orr made a detailed study of a coral pool at spring tides, and found that, though there were very considerable changes in the hydrogen ion concentration, excess base, and temperature, there was no precipitation of calcium There was a very low night tide and the oxygen saturation fell to 18 per cent, rising during the day to 230 per cent In the mangrove swamp the oxygen content and pH value fell both by day and night during the low tides, instead of only during the day as in the coral region. Miss Marshall finds that the numbers of the phytoplankton in the anchorage remain low, such slight fluctuations as there are being without apparent cause The zooplankton collected by Mr Colman weekly has become progressively poorer in numbers and variety, though spatangid plutei and *Cavolinia* appeared at the same time as at the three-mile station.

Other work by members of the boat party has included the exposure, by Mr Orr, of jars for the collection of sediment, in selected areas on the reef flat and in the lagoon These are collected weekly, and show clearly that the quantity of sediment is dependent on wind force and on the position of the jar, the sediment being mainly organic detritus mixed with some sand after stormy periods The results from the various jars have so far been quite consistent and lend no support to the theory that abundant sediment is inimical to coral growth Miss Marshall has done interesting work on the oxygen exchange of the planulæ of *Porites*, and found that, though their algæ produce a considerable amount of oxygen even at this stage, this does not balance the loss of oxygen due to respiration, also that more is produced in sunny than in dull weather

Dr T. A Stephenson has completed a new type of experiment for observing the growth rate of corals By the aid of the diving helmet, a number of colonies have been marked in particular ways *in situ*, working in about 12-20 feet of water It may be suitably mentioned here that this helmet has proved of great value, particularly in connexion with Dr Stephenson's work, but also in the collection of Mr Orr's sediment jars and of corals for experimental purposes Dr. Stephenson has continued his routine observations on the gonads of *Favia* and *Symphyllia*, and has made further progress with the ecological survey Both *Pocillopora* and *Porites* have given off abundant crops of planulæ , numbers of these have been collected and reared, detailed observations being made as to the formation of young colonies from settled planulæ. He has been engaged on manifold constructional activities on the reef flat, particularly in connexion with the rearing and collection of planulæ and the observation of the spawning of reef animals He has also made a new aquarium consisting of concrete tanks through which water runs continuously, this being particularly useful in connexion with Mrs Stephenson's work on the reproduction of reef animals, which has been continued on the lines previously reported and also extended by the examination of various kinds of spawn collected on the reef.

The work on animals of economic importance now occupies practically the entire time of Mr F. W. Moorhouse. Although his farm of *Trochus* was unfortunately destroyed by stingrays, the previous six months had shown that the average increase in diameter of specimens ranging from 2 cm to 6 cm was no less than 2 mm per month, giving a yearly increase of about 2 5 cm Growth is continuous, and no disturbance rings are found on normal shells. He has been able to confirm these figures by the measurement at each full

moon of some 600 animals taken at random, the measurements being graded into groups of 0.2 cm. and the results recorded graphically. He has now 360 sponge fragments planted out. Some are suspended from lines, others are confined in 'houses' to test the effect of the elimination of direct sunlight. Regeneration of the fragments is remarkably rapid, the supporting cord being overgrown completely or partially in two days and the whole cut surface being overgrown in ten days. The growth rate of the local oysters is being studied, while weekly gonad examinations of *Trochus niloticus*, *Holothuria atra*, and two species of edible oyster have been made regularly, artificial fertilisations being successful in all save the first. He continues to take the temperature of the water in the anchorage twice daily, and this has risen as high as 33° C., very near the lethal temperature of corals. During the recent low spring tides the temperature over the flat has risen above 35° C. and a great many corals have been killed.

Assisted throughout by Mrs. Yonge and Mr. A. G. Nicholls, I have been able to make very material progress with my work. Little further work has been done on the feeding mechanisms of corals, but it has been found that *Favia* and *Galaxea* can digest planktonic organisms of 2-3 mm. in length completely within twelve hours. The symbiotic algæ of corals possess a well-developed cellulose wall, have extensive reserve of fat, but no pure starch. A number of suitable corals have been fed with a variety of substances and polyps fixed after appropriate intervals with suitable fixatives, for the later determination of the site and mode of absorption.

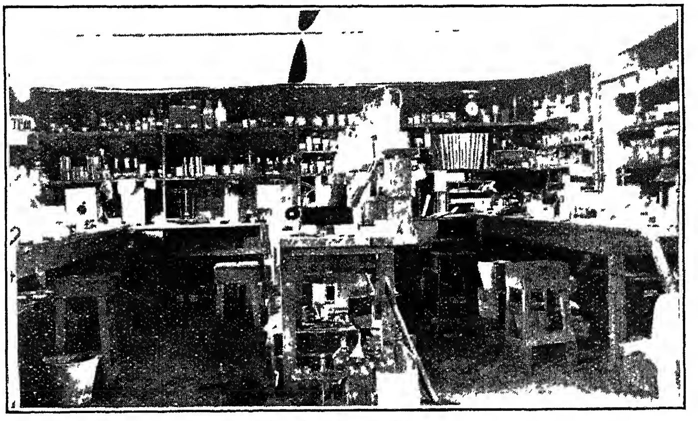

Fig. 2.—Interior of laboratory. Plankton bench on left, chemical bench in centre, director's bench on right.

The monthly experiments on the change of oxygen content in the water surrounding corals kept for similar periods in light and darkness have been continued, and confirmatory experiments on the length of time which corals can survive sealing in jars in the sea have been carried out. A large light-tight box with a detachable lid, containing a small trap door, has been cemented down on the reef flat, the object being to obtain data on the effect of continued darkness on the oxygen content and hydrogen ion concentration of the water surrounding the corals and clams (which also contain algæ) placed in the box.

Work on the digestive enzymes of corals has been almost completed, extracts of the mesenterial filaments of *Lobophyllia*, and fluid from the cœlentera of large *Fungia* being studied. In the former there is a powerful protease, of which the optimum hydrogen ion concentration has been found, an extremely weak lipase, and enzymes capable of digesting—very slowly—starch and glycogen but no other carbohydrate; the temperature of destruction and the optimum hydrogen ion concentration of the former have been determined. Apparently the extract has no action on the symbiotic algæ. Enzymes in the cœlentera of *Fungia* are confined to protease, apparently the only extracellular enzyme.

Most interesting results have been obtained from the experiment on the effect of starvation and feeding on similar corals kept in light and darkness. The starved corals receive twice filtered sea water twice daily, while the others receive unfiltered water to which is added every other night the results of a townetting. *Fungia*, *Favia*, *Psammocora*, and *Galaxea* have all given good results, and demonstrated that fed corals continue in perfect condition in both light and dark, paling somewhat in the latter owing to the death of the algæ, but starved corals quickly begin to shrink in the tissues, undamaged algæ being extruded in great numbers and the tissues consequently turning pale. This happens in both light and dark. Newly settled planulæ of *Pocillopora* were placed in light and darkness, in both cases fed, and after six weeks those in the light had abundant algæ, especially in the tentacles, while those in the dark, apparently just as healthy, were pure white with transparent tentacles. The only conclusion to be drawn from these results, taken in conjunction with the experiments on the feeding and digestive enzymes of corals, is that the algæ are not and cannot be used as food by the corals.

Mr. A. G. Nicholls has not yet been able to record a second spawning of the pearl oyster, though several small spat from the November spawning have been found. Measurements for growth rate have shown an increase of about 0.5 cm. in diameter in 30 per cent of cases. His work on calcium has shown that the calcium content of the sea water from the inside station has been remarkably steady, and that there is a noticeable diminution of calcium in water in which corals have been kept for periods of seven and fourteen days. Mr. G. W. Otter continues his work, previously outlined, on boring organisms

Mr. Spender, who had the assistance of Mr. E. C. Marchant until Jan. 9, has been busily engaged on his large-scale map of the island, a slow and laborious task Owing to the humidity causing distortion of the drawing paper, he has to plot all points by co-ordination He has taken several traverses with the tacheometer between triangulation points, the fringe of the island being almost completely mapped, and hopes to fill in the central detail by plane-tabling later He is running level traverses of a precise order across the flat

A preliminary bore with a hand plant has been made in the centre of the sand cay, 13 feet of casing being sent down, and although a lêvel below that of the 'beach rock' was reached, nothing but sand was encountered

The tide gauge has been put up after great labour, entailing the erection, with the assistance of a member of the lighthouse staff, of three 30-foot mangrove poles in the form of a tripod This is giving excellent and most interesting results, and it is now possible to refer any point on the island to mean sea-level, while sounding operations are also possible.

At the time of writing, the work of the Expedition is being greatly extended by the hiring of a powerful Townsville launch, the *Magneta*, for plankton, hydrographic, and dredging cruises as far north as Cook's passage north of Cooktown

Obituary.

COL E. LESTER JONES

THE untimely death of Col. E. Lester Jones, on April 9, meant a loss to the scientific world of a friend and ally whom it will not be easy to replace. Col Jones had been for fourteen years the directing head of the United States Coast and Geodetic Survey, and in that capacity had used his talent and energy to promote scientific work and investigation Much of the increased activity and interest in hydrography, geodesy, seismology, and terrestrial magnetism may be traced directly to his influence.

Just as it is not possible to gauge the ultimate value of any single scientific discovery, just so is it out of the question to attempt an immediate appraisal of the importance of any one man's life work in the interests of science. A hint of the monument Col Jones builded for himself may be found in the splendid organisation the destinies of which he guided for fourteen years. The United States Coast and Geodetic Survey, pioneer Government scientific bureau, is to-day functioning efficiently ; it is well organised, well equipped, and making rapid forward strides For this, the credit must inevitably gravitate toward the man who led, ever encouraged, and efficiently aided its scientific staff

Col. Jones was born at East Orange, New Jersey, on April 14, 1876. In addition to extended study abroad, he held an A B. degree and an honorary A.M. degree conferred by Princeton University, and was commissioned a hydrographic and geodetic engineer. In 1913 he was appointed deputy commissioner of the Bureau of Fisheries, holding that position until being appointed the directing head of the United States Coast and Geodetic Survey by President Wilson in 1915.

In addition to his administrative work with this latter bureau, he was the American member of the International Boundary Commission appointed to fix the boundary between the United States, Alaska, and Canada. He had also been a member of several important Government and scientific missions. One of the last of these was his appointment as a delegate to the twelfth International Geographical Congress held at Cambridge last year

DR CHARLES BEAVIS.

THE sudden death of Dr Charles Beavis on April 17 at his residence, Naishcombe House, Wick, Bristol, came as a great surprise to those who had recently seen him, apparently in the best of health and full of life and vigour. He was born at Hampstead on May 3, 1869, and educated at Atherstone Grammar School At the age of seventeen he went to Coblenz, then to Bonn, where he read chemistry, physics, and mineralogy under Kekulé, Anschutz, Klinger, Bendes, Clausius, and Hertz. He afterwards proceeded to Wurzburg, working under Emil Fischer, and in 1892 took the degree of Ph.D. (Magnam Laudem) He returned to London and worked for seven years with Dr. Quirin Wirtz, during which time he took his F.I C in 1897 In 1899 he went to Wick to start a fine colour department in the Golden Valley Ochre and Oxide Co., becoming manager in 1902, taking over the business in 1904. Although records of published original work are not available since his graduation, Dr Beavis had publicly identified himself with chemistry and the intricate problems of modern colour manufacture, and for many years took keen interest in the Colour Makers' Association of the United Kingdom, of which he was the first and only chairman.

WE regret to announce the following deaths

Prof. John W. Harshberger, professor of botany in the University of Pennsylvania and president in 1926 of the American Ecological Society, aged sixty years.

Dr. F. C. Madden, C M.G., Dean of the Faculty of Medicine, Egyptian University, Cairo, an authority on bilharziosis and schistosomiasis, on April 27, aged fifty-six years.

Dr August von Schmidt, formerly director of the meteorological-geophysical section of the Wurttemberg State Statistical Bureau at Stuttgart, on Mar. 21, aged eighty-nine years.

Sir George Syme, K.B.E., president of the College of Surgeons of Australasia and chairman of the Royal Commission on Health, Commonwealth of Australia, aged sixty-nine years.

Dr Ludwig Wittmack, honorary professor of botany in the University of Berlin and author of the section on the Bromeliaceæ in Engler and Prantl's "Pflanzenfamilien", on Feb. 2, aged eighty-nine years.

News and Views.

THE nineteenth May Lecture of the Institute of Metals was delivered on May 7 by Sir Oliver Lodge, who chose as his title "Some Ideas about Metals" A large part of the lecture was devoted to the subject of metallic conduction, a theme selected by two of his predecessors, by Sir J J Thomson in 1915, and by Prof H. A Lorentz in 1925, but by no means exhausted even now. Adopting the 'electron gas' hypothesis as to the nature of metallic conduction, Sir Oliver Lodge discussed in a fascinating manner the phenomena of thermo-electricity and the Hall effect, suggesting the lines along which a solution of outstanding difficulties may be pursued Great significance is attached to the results obtained by Kapitza in intense magnetic fields, and it is conjectured that a flow along magnetic lines of force, indicated by ether theory but too slow to be observed by existing means, might be detected if such intense fields could be extended over a considerable region instead of being concentrated in a very small space The earlier part of the lecture, however, was of wider scope, and dealt in a reminiscent vein with some of the anomalies of discovery in physics, such as the failure to recognise a new phenomenon through excessive deference to existing views and the happy results sometimes derived from the exercise of boldness in experiment or speculation. A wide range is covered by the lecture, and the student of the history of physics will find an illuminating survey of some aspects of the growth of the Bohr atom, among many thumb-nail sketches of the physical discoveries of the present generation, from the hand of a master of exposition who has himself been in close contact with such discoveries over the most interesting period in the whole history of the science

SCIENCE SERVICE, of Washington, D.C , announces that fourteen Americans and five foreigners were honoured at the concluding session of the annual spring meeting of the National Academy of Sciences, either by election to membership or to the foreign associateship Prof. Arnold Sommerfeld, of Munich, known for his work on the quantum theory of spectra, who attended the scientific sessions of the meeting as a guest, was one of the newly elected foreign associates The others included Richard v Hertwig, professor of zoology and comparative anatomy in the University of Munich ; C. de la Vallée-Poussin, professor of analytical mechanics at the University of Louvain , Willem de Sitter, of the Observatory of Leyden, Holland , and Prof F O Bower, formerly Regius professor of botany at the University of Glasgow.

THE new members of the National Academy are Dr Roger Adams, professor of organic chemistry at the University of Illinois , Irving W. Bailey, associate professor of botany, Bussey Institution, Boston ; Dr A. F. Blakeslee, botanist at the Carnegie Institution's station for experimental evolution at Cold Spring Harbor, N Y. ; Dr James B Conant, associate professor of chemistry, Harvard University ; Dr. Bergen Davis, professor of physics at Columbia University ; Dr C. J Davisson, physicist at the Bell Telephone Laboratories, New York, whose recent work on the wave nature of electrons has proved a most important advance in physics ; Dr Joel H Hildebrand, professor of chemistry at the University of California, Berkeley ; William Hovgaard, professor of naval design at the Massachusetts Institute of Technology ; Dr Albert W. Hull, research physicist at the General Electric Company's Research Laboratory at Schenectady, N.Y ; Frank Leverett, geologist of the U S. Geological Survey and lecturer in glacial geology at the University of Michigan, Ann Arbor ; Dr Paul W. Merrill, astronomer at the Mt Wilson Observatory, Pasadena, California , Dr David H. Tennent, zoologist at Bryn Mawr College, Pennsylvania , Dr. George H. Whipple, dean of the School of Medicine and Dentistry and professor of pathology at the University of Rochester, N Y. ; and Dr. Clark Wissler, curator of ethnology at the American Museum of Natural History, New York, and professor of anthropology in the Institute of Psychology at Yale

ON Feb. 13 last, Mr Frederick Chapman, palæontologist to the National Museum, Melbourne, retired from the State service, and the National Museum Committee has passed a resolution recording appreciation of the services rendered by him since his appointment on Mar. 12, 1902. During his twenty-seven years of tenure, Mr Chapman has arranged, and illustrated with his own pen and brush, the two extensive galleries of fossils in the Museum ; identified 22,000 fossil specimens for visitors ; and registered about 14,000 exhibited specimens. He has determined and labelled 7200 specimens in the reference collection of Australian fossils , and, apart from routine work, has described many hundreds of types. He is a member of the Australian Research Council and lecturer in palæontology at the University of Melbourne In March last he was elected president of the Royal Society of Victoria At present Mr. Chapman is attached to the Commonwealth service as Federal palæontologist, directing the examination of bore-cores, a work with which he is especially acquainted, for forty years ago he was helping the late Prof. J. W. Judd, of the Royal College of Science, to examine the borings from Meux's Well and from Richmond near London, whilst only last year he published a work on the Sorrento Bore. Mr Chapman's work is familiar through his writings on Foraminifera and on Australasian fossils and the recently published guide book to the Fossil Galleries at the Museum

THE Central Electricity Board, in accordance with the provisions laid down in the Electricity Supply Act of 1926, has published a report of its work up to January 1929. It will be remembered that the function of the Board is to co-operate with the supply industry in Great Britain in reducing production costs to a minimum and concurrently to increase the availability of the supply. The method of doing this which has been adopted is to interconnect the more efficient stations by a network of high pressure trans-

mission lines, called the grid, and operate 'selected' stations in the most economic way. The report indicates that good progress has been made in these directions. Many difficulties have been tactfully overcome. In central Scotland the Grampian Electricity Supply Company feared that the scheme would be prejudicial to its interests since it had counted on getting much of its revenue by supplying several industrial districts which will be connected with the grid The Board, recognising the importance of developing the water power of the country, has promised to take a load not exceeding a maximum demand of 12,000 kilowatts from the company

THE report goes on to state that in south-east England the demand has increased so rapidly that three additional stations had to be selected by the Central Electricity Board The difficulties that were expected to arise owing to the standardisation of the frequency of the supply in central England and North Wales have been carefully considered, and in several cases the Board has given permission for schemes at a lower frequency to be completed, as the savings under the scheme would not have justified the higher expenditure The total value of the work contracted for under the Government scheme up to the end of last year exceeds eight million pounds. In Scotland the erection of towers in the Clyde Valley will be completed this month In south-east England towers are being built between Bedford and Little Barford, and forty-six out of seventy-three are now erected One very satisfactory feature is that many landowners have facilitated the work and co-operated with the Board in preserving the amenities of the countryside by choosing the most suitable sites for the towers.

AT a recent meeting of the Council of the Institution of Professional Civil Servants the announcement of the appointment of a Royal Commission on the Civil Service, with the wide terms of reference indicated by Mr Churchill in the House of Commons, was considered. While welcoming such a Royal Commission, the Council is of opinion, however, that such an inquiry can only discharge the task imposed upon it satisfactorily provided that professional and scientific men of standing and administrative experience are appointed to serve on the Commission In its view, the problem of the structure of Civil Service organisation must be approached afresh in relation to the functions which should be accorded to the 'technical expert' in the administrative machinery of the modern State. An approach from the traditional Civil Service point of view is considered unlikely to lead to those fundamental changes which are rendered necessary by modern conditions

IN a reprint of certain articles published in the *Journal* of the American Society for Psychical Research during 1928, and now issued under the title of "The Thumbprint and Cross-Correspondence Experiments made with the Medium Margery during 1927 and 1928," Dr Mark W. Richardson and his associates have collected some of the more striking episodes in the later history of the development of the alleged supernormal phenomena occurring with the Boston medium, Margery (Mrs. L R. G Crandon). The paper is divided into two sections, one dealing with the thumb impressions upon dental wax which have so far been traced to no living person, and the other to the series of cross-correspondences between Margery and other mediums, which have the merit of simplicity, and possess a degree of accuracy which would be regarded with suspicion if it represented any kind of scientific result There is little doubt that, merely considered as a question of mechanical production, the thumb prints are of some interest. Unlike the prints which engage the attention of the police, the Margery impressions are made in wax, and are therefore capable of more detailed examination and analysis than are those of two dimensions. Moreover, the fact that these wax impressions are said to be negative *and* positive together with 'mirror' images of both these series serves to illustrate the complexity of the problem.

THESE wax originals are open to inspection in Boston, and it is clear that an examination of them would be more satisfactory than of the photographs here included, excellent though the latter undoubtedly are Hence any detailed criticism would be out of place, although it ought to be said that in the account there are certain suspicious incidents which again are not absent in the records of the cross-correspondences. Here we have broadly what is claimed to be the transmission of an idea independently chosen and presented which is reproduced at approximately the same time by two or more mediums at widely separated distances. Such a claim lends itself to scientific scrutiny, and it would appear that, under much stricter conditions than those described in this paper, it might be possible to test these phenomena in a manner free from those objections which usually prevent any adequate examination of supposed 'psychic' manifestations.

THE Right Hon W Ormsby Gore, Under-Secretary of State for the Colonies, recently gave an address before the Royal Scottish Geographical Society on the "Development of our Tropical Dependencies", and the lecture has now been published in the Society's magazine He points out that in the true equatorial territories the combination of high rainfall, perpetually humid atmosphere, and comparatively high temperatures, provides all the circumstances necessary for constant and rank vegetable growth On the north and south, these regions are bounded by great torrid deserts with a rainfall lower, and a temperature far higher, than those found in the true equatorial belt The wealth of the tropics lies mainly in the production of certain foodstuffs and raw materials, which are becoming of increased importance year by year. Despite the bountiful and productive nature of the true equatorial regions, there is, however, an extraordinary sparseness of human population A variety of causes retard development, among which the more important are tropical diseases, the ravages of mosquitoes and tsetse flies which attack man and animals, and the prevalence of plant diseases For

the development of the tropics, further research work in tropical medicine and veterinary science is all important In agriculture, also, research is vital, since immune varieties of higher yielding strains of particular crops are urgently required Mr Ormsby Gore considers that it is in the fields of economic botany, plant genetics, and soil science that the economic conquest of the tropics has its future In tropical agriculture, medicine, and veterinary science the main problems now to be faced are not so much the cure of diseases as and when they arise but rather the eradication of disease and the maintenance in health of men, animals, and plants

THE first number of *Human Biology*, a new magazine with a definite and specific aim, has made its appearance from the Institute for Biological Research, under the editorship of Prof. Raymond Pearl Its object is to publish in readable English original articles in all fields of human biology, including physical and general anthropology, anthropometry, vital statistics, human heredity and eugenics, prehistory, human anatomy, sociology, constitutional pathology, and psychobiology. There was need for such a work, for not only has it become increasingly apparent that humanistic researches must all wander into biological fields, but also the publication of papers on human biology found their way into many and scattered journals, and lost the value of a massed attack. The first part—the journal is to be a quarterly—contains a varied series of papers, dealing with subjects from human evolution to biological philosophy and medicine. All the articles are stimulating in their suggestiveness, but a perusal of some suggests that the editor is to have a hard task to capture the standard of thorough and entertaining readableness at which he aims through his contributors There are no book reviews, but a list of new books and memoirs received at the editorial office is printed as a bibliographical guide. There is a niche for *Human Biology*, and this it promises to fill very satisfactorily

DR FRANK B. JEWETT, of New York, who has recently been honoured by the American Institute of Electrical Engineers, gave an address on Dec. 29 last to the American Association for the Advancement of Science, which has appeared in a recent issue of *Science*, on leadership in industrial research As one of the founders of the Bell Telephone Laboratories, and as one who has been engaged for the last twenty-five years in finding and encouraging others to do scientific research in industry, his paper deserves consideration by scientific and technical professors. He has worked all his life to promote co-operative research, not with any idea of banishing the individual inventor, especially if that inventor happens to be a genius, but in the belief that co-operation provides a new method of research In both scientific and industrial research the men who succeed are driven to work by insatiable curiosity about natural laws and not mainly by a desire for personal wealth. Looking back over his successes and failures in selecting young men for industrial research during the last twenty-five years, Dr. Jewett says that the majority of his successes were secured by attaching one-third weight to his own personal appraisement and two-thirds to that of experienced professors under whom the candidate had worked. His failures were mainly due to paying too little attention to the professorial opinion and to attaching too much weight to those whose judgment he should have distrusted In order to promote the peace of mind and the continued productivity of the research worker, it is necessary to encourage him by a sympathetic understanding of the work he has done and the obstacles he has to overcome We are human beings dealing with each other, and no hard-and-fast rules can be applied to workers in the field of research any more than in any other field of activity.

A FURTHER Circular (No. 6) has been issued by the secretaries of the International Congress of Forestry Experimental Stations to be held in Stockholm next July, which has been referred to in previous issues of NATURE So far, about a hundred applications to attend the Congress have been received and fifty papers have been presented to be read, the latter chiefly from Europe and the United States It is proposed to set up an organising committee, consisting of one representative from each country, which will deal with questions concerning the organisation of the Congress and the revived International Association of Experimental Stations. This Committee will have the power to summon experts to its meetings, which will not clash with the general meetings of the Congress, to assist in the solution of such problems as may arise, small executive sub-committees will be appointed when deemed necessary. Delegates submitting papers are requested to send in a précis of their papers at once, in order that such summaries may be printed and thus be in the hands of delegates before the meetings at which the papers are read. It is further announced that the period of application to attend the Congress has been extended to June 1, although the date of giving notice regarding attendance at the excursions to take place before and after the Congress meetings was left at April 30 The meetings in Stockholm will take place on July 22–27 The first meeting of the organising committee will be held in the afternoon of Sunday, July 21, and this will be followed by a garden party at the beautifully situated College of Forestry at Stockholm, to which all delegates are invited The proceedings of the Congress will open on July 22, and the programme of the first two days' meetings is given in the circular. The last meetings of the Congress will be held on Saturday, July 27, when resolutions will be submitted, the election of a president, and the time and place of the next meeting, and the appointment of an executive committee of the Association will be discussed.

IN a recent issue of *Science*, Prof Knight Dunlop has a paper on the outlook for psychology, presented before the New York meeting of the American Association for the Advancement of Science. He reviews the present situation with special emphasis on what he calls the laboratory method, believing that the laboratory is the centre of true psychological activities. It is dis-

appointing that such a subject should be treated so generally; he asserts, but presents no evidence, that the laboratory method has justified itself and contrasts it with the mental test movement and the psycho-analytic movement, both of which he looks upon as in a state of eclipse. One cannot help feeling either that the position of psychology in the United States is radically different from what it is in Britain, or that Prof. Knight Dunlop is comparing the best work of the laboratory with the worst and most uncritical of the practical movements. There is no inherent opposition between the laboratory method and scientific method pursued in the field for practical purposes. The laboratory worker in psychology, as in any other science, can pursue knowledge for the sake of knowledge, regardless of possible practical applications, but he can also receive his stimulus to work from the practical side and pursue his research scientifically with a practical aim. The mental tester in his domain and the doctor in his, were confronted with serious problems Neither of them could wait until, if ever, the laboratory worker bestirred himself to help him. Because both movements have had over-enthusiastic exponents and reckless theorisers, one cannot look upon them as discredited. So also has the theory of evolution. Perhaps in England less was expected of either mental testing or psycho-analysis, and therefore they have been kept in better perspective. In the latest edition of Osler and M'Crae's "Modern Medicine", there occurs the statement: "Psycho-analysis is of the greatest service for the strictly psychogenic cases", and the mental test is used not as a method of universal validity, but as a convenient measure of differentiation.

The effect of the erection of overhead power lines on the beauty of the countryside has been much discussed in the Press. Electrical engineers are, however, more concerned at present with the possible interference these high voltage lines may produce with telephone lines, radio transmission, and broadcast reception. Dr. R. L. Smith Rose has been experimenting, on behalf of the Radio Research Board, at the National Physical Laboratory on this subject and has arrived at definite conclusions. These are given in the *Wireless World* for May 8. American experience has shown that if the radio reception station be farther than about half a mile from a high-tension overhead line, no interference or disturbing effects will be experienced. The station itself may, without causing interference, be supplied with power from the overhead system. Experiments were made by Dr Smith Rose to find out the effects of high voltage spark discharges on a sensitive radio receiver in the neighbourhood When a spark or arc discharge initiated by a voltage of about 850,000 and carrying a current of about half an ampere took place, then if the receiver were less than 200 yards from it, disturbance ensued. This effect was only serious when long drawn arcs occurred at frequent intervals, a phenomenon which would very rarely happen on transmission lines. When the distance was so great as 600 yards, the interference was negligible. The distance, therefore, of half a mile which is customarily chosen for other reasons ensures that the disturbing effects produced by 'man-made static' are negligible

Test transmissions of the new Marconi broadcasting station at Bratislava, Czechoslovakia, have been carried out and satisfactory reception has been reported, generally on three-valve sets, from all parts of the British Isles. The new station comprises a Marconi 12-kilowatt broadcasting transmitter, Type P.A 5, employing the principle of low-power modulation Its wave-length is 277·8 metres (1080 kh), and among its special features is the half wave-length ærial, the first of its kind to be used in the broadcast band of wave-lengths. The station, which is situated about three miles to the east of the town, replaces an old broadcasting station of ½-kilowatt power It is connected by land line with up-to-date studios in the centre of Bratislava, Prague, and Brno.

The Fourth World's Poultry Congress is to be held at the Crystal Palace on July 22–30, 1930. It is being organised by the English Ministry of Agriculture and Fisheries in conjunction with the Scottish Department of Agriculture and the Ministry of Agriculture for Northern Ireland. The official host is the Government, and Their Majesties the King and Queen and H.R.H the Prince of Wales have consented to become its patrons. National committees have been formed in most countries for the purposes of organising national exhibits, and of selecting papers to be read at the Congress. The business activities of the Congress will consist of paper-reading sessions, national displays of live-stock, and commercial exhibits. Whilst most that is to be heard and to be seen will deal with the democratisation of information relating to poultry-keeping, there are to be in addition special paper-reading sessions devoted to the presentation and discussion of original scientific contributions in genetics, dietetics, pathology, and husbandry. This Congress is expected to be no less successful than the last, which was held at Ottawa in 1927, when 3000 delegates and 200,000 members of the general public attended.

A formidable and very widely spread insect pest of fruits, namely, the Mediterranean fruit fly (*Ceratitis capitata*), has recently, and for the first time, secured a footing in the United States. We learn from recent *Daily Science News Bulletins*, issued by Science Service, Washington, D.C., that its discovery in citrus orchards in Florida, over an area of about 40 square miles, has led to the planning of energetic measures of repression The fly was first found on April 6 and its identity established soon afterwards. Specimens were then rushed by air mail to Washington and the identification confirmed. It is stated that within one week of the date of discovery, 75 entomologists and plant experts were on the ground, and the battle of extermination has begun!

The Bakerian Lecture of the Royal Society will be delivered by Prof. E. A. Milne, Rouse Ball professor of mathematics in the University of Oxford, on June 6, the title being "The Structure and Opacity of a Stellar Atmosphere".

AT the annual meeting of the members of the Royal Institution, held on May 1, the following officers were elected :—*President* : The Duke of Northumberland ; *Treasurer* : Sir Robert Robertson ; *Secretary* : Major Charles E. S. Phillips.

THE President of the French Republic has, on the recommendation of the Association Technique Maritime et Aéronautique, conferred the Legion of Honour upon Mr. Robert W. Dana, secretary of the Institution of Naval Architects.

THE first Pedler Lecture of the Chemical Society will be delivered by Prof. W. H. Perkin, Waynflete professor of chemistry in the University of Oxford, on Thursday, May 30, at 5.30 P.M., the title of his lecture being "The Early History of the Synthesis of Closed Carbon Chains". The lecture will be given in the hall of the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1. Tickets of admission will not be required.

'NATIONAL Baby Week' is to be celebrated this year in Great Britain on July 1-7. The National Baby Week Council desires that special attention should be directed to three problems: (1) The practical measures that can be taken to combat maternal mortality, morbidity, and disability; (2) what local authorities and parents can do to lessen the incidence and dangers of infectious diseases among young children; and (3) the teaching of parentcraft and hygiene to school children. Particulars may be obtained from the Secretary, Miss Norah March, 117 Piccadilly, W.1.

A PUBLICATION grant of £2500 is receivable by the Royal Society from H.M. Government during the current year. The grant is available for assisting the publications of other scientific societies, as well as for assisting the separate publication of books, memoirs, etc., of a scientific nature. Applications for grant will be adjudged by the Council of the Royal Society at its meeting early in July, but should be received before the Council meeting of June 13. Applications from societies will be received by the secretaries of the Royal Society; those from individuals must be brought forward by members of Council.

THE second meeting of the Internationale Gesellschaft fur Sexualforschung will be held in the house of the British Medical Association, Tavistock Square, London, on Aug. 3-9, 1930. It may be assumed that, as was the case in Berlin, the papers presented for discussion will fall into the following groups: biology; physiology, pathology, and therapeutics; psychology, pedagogy, ethics, æsthetics, religion; demography, statistics, social and racial hygiene; sociology, ethnology, and folk-lore. All arrangements are in the hands of Prof. F. A. E. Crew, The University, West Mains Road, Edinburgh, to whom all those who are interested are requested to write.

THE cheap popular series of books which have long been a feature of publishing enterprise fall into two main divisions; those which have long attained the rank of classics, and those which provide expositions, brief but authoritative, of new problems, or of problems which have assumed new forms or a new importance. Of the latter kind of cheap series, "Benn's Sixpenny Library" is one of the most remarkable (London: Ernest Benn, Ltd.). To mention three examples, rather wide apart as to subject matter, from a number of volumes which have recently reached us—Dr. Cyril Norwood on "The English Educational System", Mr. E. N. Fallaize on "The Origins of Civilisation", and Lord Monkswell on "Railways"—is to convey some idea of the comprehensiveness of the series. Many of the volumes dealing with scientific subjects have been noticed separately in NATURE. As at present arranged, the series is to run to some two hundred and fifty books, of which we have already received about a hundred and fifty. The undertaking is one which deserves, and we trust is commanding, success.

A CORRESPONDENT in Tanganyika has directed attention to an error in the provenance of the wooden dolls described in NATURE of Mar. 9, p. 388, where they are attributed to West Africa. This should be East Africa, as the Wamakonde, by whom the dolls were made, are native to Portuguese East Africa.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A soil analyst in the West of Scotland Agricultural College —The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (May 24). An assistant lecturer in chemistry and an assistant lecturer in biology at the Brighton Technical College —The Secretary, Brighton Technical College, 54 Old Steine, Brighton (May 25). An assistant at the Forest Products Research Laboratory, Princes Risborough, for work on the identification and structure of wood—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (May 25). Temporary assistant chemists at the Government Laboratory—The Government Chemist, Clement's Inn Passage, W.C.2 (May 25). An assistant master to teach mathematics at the Toxteth Junior (Day) Technical School—The Director of Education, 14 Sir Thomas Street, Liverpool (May 25). A part-time demonstrator in chemistry at King's College of Household and Social Science—The Secretary, King's College of Household and Social Science, Campden Hill Road, W.8 (May 29). A demonstrator in the mechanical engineering branch of the Military College of Science, Woolwich—The Assistant Commandant, Military College of Science, Woolwich, S.E.18 (May 31). A pathologist and curator at the Royal London Ophthalmic Hospital—The Secretary, Royal London Ophthalmic Hospital, City Road, E.C.1 (May 31). An assistant lecturer in physical chemistry in the University of Sheffield—The Registrar, The University, Sheffield (June 3). A demonstrator in the department of physiology of Middlesex Hospital Medical School—The School Secretary, Middlesex Hospital Medical School, London, W.1 (June 5). A professor of mechanical engineering at the College of Engineering, Guindy, Madras—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (June 8). A research chemist in the department of Coal Gas

and Fuel Industries of the University of Leeds—The Registrar, The University, Leeds (June 9). A lecturer in civil engineering in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (June 11). Two research fellows in the Department of Chemical Technology of the Imperial College of Science and Technology for work in connexion with the carbonisation of coal, gaseous combustion or catalytic reactions—The Registrar, Imperial College of Science and Technology, South Kensington, S.W.7 (June 15). Three assistants in the Research Department, Woolwich, under the Directorate of Explosives Research—The Chief Superintendent, Research Department, Woolwich, S E.18. An examiner in the Aeronautical Inspection Department, Air Ministry, Kidbrooke, S E.—The Secretary (I.G.), Air Ministry, W C.2 A temporary woman lecturer in geography at the Warrington Training College, temporarily at St John's College, Battersea—The Principal. An assistant in the Public Health Laboratories and Bacteriological Department of the University of Durham College of Medicine—The Registrar, University of Durham College of Medicine, Newcastle-upon-Tyne.

Our Astronomical Column.

THE TOTAL SOLAR ECLIPSE OF MAY 9.—Unfortunately, the news from the official British parties at Alor Star and Patani are very disappointing At the latter station nothing could be done owing to thick clouds. At the former the clouds were thinner, and some plates were exposed, but it is feared that they will be of little value.

Fortunately, the parties in Sumatra and the Philippines had better conditions Iloilo (Philippines) was occupied by American and German parties from the Naval Observatory, Washington, and from Hamburg. There were also two English observers, Dr. R. L Waterfield and Mr W Lloyd. There was a little high cirrus cloud here, but it does not appear to have interfered much with the observations; there was a fine flag-shaped prominence, which the Americans humorously compared to the 'Stars and Stripes'. The corona was of maximum type and had six-pointed streamers; Dr Waterfield reports that it was brighter and more extensive than that of June 1927, but the darkness during totality was not so great. He states (*Daily News*, May 11) that the infra-red plates overcome thin clouds and give the corona a harder outline, but no greater extension, than ordinary plates A kinematograph film was exposed during totality by the Washington party, but this had not then been developed.

Some of the parties in Sumatra report some interference by cloud, while others enjoyed very good conditions. Prof J. A Miller, of Swarthmore Observatory, who probably holds the record for the number of eclipses he has observed, took coronal photographs with a camera of 65-feet focus; comparison of his plates with those taken in Iloilo will reveal any coronal changes that may have taken place in an hour. Prof. E. F. Freundlich, from Potsdam, has telegraphed that he obtained successful results. He was studying the Einstein bending of light, a problem on which he was engaged even in pre-War days, before the publication of the general theory of relativity. This is the third totality that has been successfully observed in Sumatra in the present century; the others were 1901 and 1926.

Since the above was written, a Reuter telegram received from Dr. Jackson at Alor Star reports as follows: Developed plates better than anticipated. Transparencies equal to that of Giggleswick. Several beautiful prominences, one 150,000 miles long, 100,000 miles high, with coronal arches. Apparatus for velocity in the corona satisfactory.

THE PLEIADES.—At the meeting of the Royal Astronomical Society of May 10, the George Darwin Lecture was delivered by Prof. Ejnar Hertzsprung, of Leyden Observatory. He chose as his subject the Pleiades, and began with describing the methods by which the stars of the cluster could be discriminated from background stars by photographic determinations of their proper motions Slides were shown of the proper motions of each magnitude of stars from the third to the fifteenth The brighter ones are all cluster stars, it is only in the case of the faintest stars that any doubt arises as to which belong to the cluster, and even here there are only one or two doubtful cases.

Prof Hertzsprung then proceeded to divide the stars into the spectral classes, which was done for the fainter stars by their colour indices. There are no red or yellow giants, the brightest stars being of type *B*, and the faintest being red dwarfs. Prof. A. S. Eddington remarked after the lecture that the resulting diagram of spectral type and absolute magnitude brought out the 'main sequence' more vividly than he had seen before, since it was the first time that such a large number of stars, all known to be at the same distance, had been studied. The globular clusters are too remote for the dwarf stars in them to be seen. The colour indices of the non-cluster stars in the region were also determined; there was some reason to think that they were rather redder than the average, which might possibly be caused by the presence of the nebulosities round the principal stars.

Prof. Hertzsprung adopted the parallax of the cluster as 0 0065″, which is smaller than some other estimates, which go up to 0 01″. He ascribed the proper motion almost entirely to the motion of the solar system.

MEASURING THE HEAT OF THE STARS.—The May *Scientific American* contains an account by Prof. H. N. Russell of the very delicate measures of stellar heat made by Messrs E. Pettit and S. B. Nicholson with the 100-inch reflector at Mount Wilson The wires of the thermocouple are about one-thousandth of an inch in diameter and weigh 1/600 of a grain. Betelgeuse is the star that gives us the most heat, but even this only raises the temperature of the wire on which it falls by 1/60 of a degree, and produces a current of one seven-millionth of an ampere. This, however, suffices to move the spot of light reflected from the mirror of the galvanometer through 18 inches. Some stars invisible to the naked eye give a measurable displacement. The next in order after Betelgeuse are Antares, Sirius, Canopus, Gamma Crucis, Arcturus, Alpha Herculis, Aldebaran, Mira at its maximum. It is noted that a very red star, such as Alpha Herculis, sends us 50 times as much heat as a white star of the same visual magnitude, in spite of the fact that the surface temperature of the first is only 2300°, that of the second being 6000°. The article contains a picture of the thermocouple used by Dr. W. W. Coblentz for measuring the heat received from the planets.

Research Items.

THE RELIGION OF MENTAWEI —Mentawei Islands, lying west of Sumatra, owing to political conditions, have received more attention from Dutch and German than from English-speaking ethnologists They were, however, visited in 1926 by Mr Edwin M Loeb, as a research scholar of the University of California, and he has now published an account of the religious organisation of the Pageh group of islands in the *Publications in American Archæology and Ethnology*, vol. 25, No. 2 of that University. He deals more especially with the *punen* system. The *punen* is the community religious festival (as distinct from the *lia* or family festival) which is attended by all members of the *uma*, the communal house The festival is of long duration, sometimes lasting for years It takes place at the building of a new communal house, the choice of a new priest, the making of a new field, the spilling of blood in the village, an epidemic, and so forth The main ceremonial acts are the slaughter of pigs and chickens, the sacrifice of their livers and haruspication. The souls of the dead members of the *uma* are invoked to return, and imitative dances are held, and towards the end of the festival monkeys, deer, and sea turtle are hunted. All men sleep in the *uma* and sexual intercourse is taboo. The religious beliefs of the Mentawei Islands are animistic They believe in nature spirits, souls, and ghosts, but the nature spirits, with a few exceptions, are not given names They are the spirits in the sea, the jungle, and so forth. The exceptions are a god who causes earthquakes, the original meaning of his name being ' grandfather '. It is on account of this god that a human sacrifice used to be offered at the building of the *uma*. Other specially designated gods are two water spirits, the first being propitious if due sacrifices are offered and no ritual sin has been committed, and the second is evil. The soul cult is specially directed to the preservation of health and long life, while ghosts are the bringers of disease to whom prayer is offered for purposes of witchcraft, and to whom sacrifice is made only when they have entered a village bringing sickness, to induce them to go away.

THE REGENT'S PARK MEDUSA.—Prof C L Boulenger and W. U. Flower (*Proc Zool. Soc.*, Part 4, 1928) record observations on the freshwater medusa, *Craspedacusta* (*Limnocodium*) *sowerbyi*, which reappeared in the *Victoria regia* tank in the Royal Botanic Society's Garden in Regent's Park in 1928 (see also NATURE, July 14, 1928, p 58) The youngest specimens—about half a mm in diameter—agree in structure with the description of American examples of the medusa of *Microhydra ryderi* The latter is therefore merely the young stage of *C. sowerbyi*. The description given of *Microhydra germanica* shows that it corresponds with the young forms of *C. sowerbyi*, and the Chinese species *Limnocodium kawaii* is also a synonym The Japanese *C. iseanum* is clearly differentiated by the structure of its sense organs The living *C sowerbyi* passively sinks in the water, the velum hanging downwards from the umbrella margin and the tentacles floating upwards, the lip of the oral opening of the elongate manubrium being widely extended so as to catch organisms In addition to this ' tow-net ' method of feeding the medusa can feed on bottom-living forms, for the stomach has been recorded filled with *Arcella*. The authors consider that the increase in size of the mouth and the large manubrium of *Limnocnida* show that this genus has become more perfectly adapted to the tow-net method of feeding, but the radial canals are shortened and the sex-cells remain in the manubrial ectoderm, that is, in the primitive position in which they first appear in the young *Craspedacusta*

THE MUSKRAT IN EUROPE —In 1905 the American muskrat (*Fiber zibethicus*) was introduced into Bohemia on an estate near Prague, where it was hoped that it would breed and help to supply the demand for musquash fur which was then in fashion The experiment succeeded better (or worse) than was expected, for the colony burst out of control and soon mid-Bohemia was overrun. About 1914, Bavaria and Saxony were invaded, in 1924 Silesia; and in 1928 the outposts were still spreading (Hj Broch in *Naturen*, January 1929) The extent of the conquest may be judged by the fact that in 1921, 60,000 to 80,000 muskrat skins were sold in Berlin at prices which compared favourably with those obtained for American skins Such an invasion could not but have its ill-effects The muskrats, largely vegetarians, have attacked corn, potatoes, kohlrabi, turnips, and carrots. They have extended their carnivorous diet to frogs and fish, and the damage caused by their burrows to road and railway works has not been negligible. Strenuous measures have been adopted against the pest in the affected countries, in Bavaria special muskrat catchers have been appointed. The whole story is but another illustration of the danger of introducing animals in casual and unconsidered ways to new countries, and it strongly supports Dr. Broch's plea that there should be no relaxing of the law forbidding the importation of live muskrats into Norway.

ANIMAL HYPNOSIS —J. ten Cate (*Biol. Zentralbl.*, Bd. 48, Heft 11) discusses the problem of animal hypnosis. Czermak (1856) found he could produce complete immobility in the newt by suddenly seizing with forceps a leg or the tail. Similar immobility after a sudden strong stimulus is met with in other animals, especially in insects, and is known even in a few mammals. But there are other cases in which the hypnotic condition is brought about by much weaker stimuli lasting for a longer period, for example, in consequence of holding the animal, by the suppression of the reactions of flight, defence and turning over, by transient pressure on definite parts of the body, by continuous gentle contact, etc. Hypnosis in these cases appears only under quite definite conditions and its origin is by no means so simple as has been assumed. The author describes experiments with the skate, the cockroach, the salamander, the rabbit, and the octopus, in which hypnosis was produced by the action of definite stimuli. He proceeds to refer to the condition of the musculature and to discuss the origin of hypnosis in animals. He concludes that in the vertebrate series the significance of the cerebrum for the realisation of the condition of hypnosis becomes the more important according to the higher grade of development of the central nervous system. Among the invertebrates the general rule appears to be that the higher the animal the more significant are its cerebral ganglia in regard to the origin of hypnosis.

CHROMOSOMES OF MAIZE —A useful study of chromosome numbers in many different varieties of maize has been made by Randolph (*Memoir* 117, Cornell Univ. Agric. Expt. Station), who used the iron-acetocarmine method. All the different types of maize, including dent, flint, pop, and sugary, were examined,

including both meiotic and somatic chromosomes, and the chromosome counts in 338 plants were determined. In accordance with previous work, the typical diploid number was found to be 20 in all varieties. But plants with a higher number were found in two sugary and two starchy varieties, and in certain other cultures. In the exceptional cultures the numbers ranged from 21 to 28, but were constant in each individual, with rare exceptions. The chromosomes vary in length from about 2 microns to 4.5 microns, and the extra chromosomes were of the smaller size. Segmentation, fusion, duplication through non-disjunction, and hybridisation are discussed as methods by which the additional chromosomes may have arisen, but further studies are necessary before the exact method can be determined.

SOFT-WOOD IMPORTS INTO NEW ENGLAND.—Much has been read of the threatened famine in soft-wood coniferous timber supplies, and the matter is admittedly one deserving the closest attention. The intricacies of the question are very considerable, both in the Old and the New Worlds. A point bearing on this matter was discussed by Mr. Franklin W. Reed, of the National Lumber Manufacturers' Association, at the recent New England Forestry Conference (*Daily Science News Bulletin*, Science Service, Washington, D.C.). Mr. Reed stated that shipping lumber to New England, traditionally a forested region, seems like carrying coals to Newcastle; yet lumber is being shipped into the State and no tariff wall can keep out the invading lumber, for it is American lumber from the Pacific north-west. It comes into the New England market, partly because the digging of the Panama Canal has made intercoastal freight rates cheap, and partly because the Pacific lumbermen have been caught in an economic trap of overproduction and have to dispose of their product at abnormally low prices in order to maintain their establishments. "The present unfavourable condition, from the point of view of the New England producer, will end", said Mr. Reed, "when the excessive exploitation of the virgin stands of the Pacific coast is ended, either through agreement among the lumbermen or through exhaustion of the more easily accessible timber." Although New England may look with equanimity to such exhaustion, it would prove a serious matter for wider United States and world markets. In the meantime, however, New England timber owners and lumberers are advised to consider the possibility of exporting hardwood products to the Pacific States via the Panama Canal. This section, it is pointed out, though possessing a surplus of soft-woods, has almost no hardwood resources and is now importing oak from Japan. It appears possible, therefore, that an exchange of New England birch, beech, and maple for Pacific Coast soft-woods might prove an economic possibility.

WATER-COOLED MERCURY VAPOUR LAMPS.—The Lummer and Straubel mercury vapour lamp, which furnishes a very bright light-source of small extent and proves most useful in spectroscopic work and as a subsidiary to devices for obtaining monochromatic light, has the disadvantage that it requires to be cooled in a current of water. In the *Rendiconti* of the Royal Lombardy Scientific and Literary Institute for 1928, Dr. Luigi Piatti, of the University of Pavia, describes a simple arrangement, which both prevents the lamp from coming into action unless the water is flowing and extinguishes it automatically if the water supply fails. Moreover, the arrangement is such that the electric circuit in which the lamp is inserted is kept well insulated from the cooling water.

FUNDAMENTAL CONSTANTS.—Prof. A. S. Eddington's theory of the relation between certain of the fundamental constants, to which several references have been made in NATURE this year, lends particular interest to two new numbers which have been published recently. H. Feder, working in the late Prof. Wagner's laboratory at Wurzburg, who has remeasured Planck's constant h by a method based on the excitation of the continuous X-ray spectrum, now finds for it a value of $6{\cdot}547 \pm 0{\cdot}003 \times 10^{-27}$ erg. sec. H. D. Babcock, of the Mount Wilson Observatory, has revised a previous estimate of the specific charge of the electron (e/m) which he had made from the magnitude of the Zeeman effect for a number of spectral lines of known spectral types, and gives as its value $1{\cdot}7606 \pm 0{\cdot}0012 \times 10^7$ e.m.u./gm. In each case the changes called for in the older standard values are less than one part in a thousand, although it has to be remembered that the former method presupposes a knowledge of the actual charge on an electron (e), and the latter a knowledge of the velocity of light. The accounts of the two investigations are published in the *Annalen der Physik* (vol. 1. No. 4), and in the January issue of the *Astrophysical Journal* respectively.

QUANTUM MECHANICS.—Dr. P. A. M. Dirac has reviewed some of the more recent developments of quantum theory very lucidly in the introductory paragraphs of a paper in the issue of the *Proceedings of the Royal Society* for April 6, on the properties of many-electron systems. Quantum mechanics is defined as "the general theory of all quantities that do not satisfy the commutative law of multiplication". Dr. Dirac considers that the general theory is now almost complete, apart from the question of the exact form in which relativity considerations have to be introduced. The latter, however, are only of importance where high-speed particles are concerned, and so the underlying physical laws necessary for the mathematical formulation of a large part of physics and the whole of chemistry may be regarded as completely known; the difficulty is only that insoluble equations are frequently encountered in the applications of these laws to specific systems. Dr. Dirac has given a sketch of the history of the spinning electron which brings out clearly the nature of the problem presented by the interaction of the orbital electrons of atoms and of molecules, and the way in which the impasse which this presented was removed by recognition of the fact that the electrons are actually indistinguishable one from another, and so can change places without our knowledge. This 'exchange' type of interaction leads also to satisfactory theories of homopolar valency and of ferromagnetism. Dr. Dirac's main object in this paper has been to take the ideas and results of group theory, which has been used extensively by German theoretical physicists, and to translate them into the more general and apparently simpler language of quantum mechanics, a transformation which appears to have the additional advantage that it often enables a simple physical meaning to be attached to an otherwise abstract theorem.

GRID CONTROL IN ARCS.—I. Langmuir and A. W. Hull have contributed a paper to the March number of the *Proceedings of the National Academy of Sciences* of the United States, from which it would appear that considerable developments in the use of enclosed arcs may be expected in the near future. The principle underlying the construction of the new tubes is the combination of grid control of the current from a hot cathode with conduction through an ionised gas, with the essential reservation that a

circuit can be made by raising the potential of the grid, but cannot be broken by again lowering it; a negative grid in a strongly ionised medium simply attracts to itself a thin sheath of positive ions, which act as a perfect electrostatic shield to the main body of the discharge To stop a current flowing, the anode potential must be reduced to the neighbourhood of the ionising potential of the gas, and hence the grid does not affect the instantaneous value of the anode current, but only its average value. The action of the grid, once a discharge has been started, is in fact the same as that of the small exploring electrodes that are now used in the investigation of many types of gaseous discharges More details of the arc tubes are being given by Dr Hull in a series of articles in the *General Electric Review* Perhaps the most remarkable feature of the first of these—in the April number—is the shape which is now being given to the electron-emitting surfaces of the cathodes The bare filament type has been almost abandoned, and there has been substituted an elaborate structure of appropriately coated ribbons or vanes, in the design of which special care is taken to ensure that the emitting surface is efficiently insulated thermally These tubes have already been made in metal, as well as in glass

Breeze and Clinker Aggregates—Concretes made from furnace residues as aggregates often develop cracks within a short time of setting, and the causes of such failures have been investigated at the Building Research Station. The experimental methods employed and the results obtained are described in detail in *Technical Paper, No. 7*, by F. M. Lea (London H M. Stationery Office). Many breezes and clinkers contain combustible matter and even unburnt coal, and it is this material that is, in general, responsible for failure The absorption of moisture and the oxidation of the coal cause swelling movements which may continue over a period of some days, and are particularly noticeable during the setting period and early life of the concrete. The presence of more than 40 per cent of combustible material in the breeze invariably results in a low-grade concrete, and the properties of the concrete improve as the combustible content decreases Failure due to the presence of sulphur or its compounds appears to be rare, and up to 0 4 per cent of sulphur as sulphate and 0 75 per cent in other forms, is permissible Other impurities do not appear to cause failure.

A Method of producing Sound Steel Ingots—In a paper read before the Iron and Steel Institute on May 3, Sir Charles Parsons and H M Duncan described an experiment carried out on a large scale to produce steel ingots of exceptional soundness. The mould used consists of a strong steel casing lined with specially shaped firebricks and is closed by a cover similarly constructed and a bottom chill of steel or cast iron of large dimensions Through the cover are openings for the pouring of the steel, the escape of gases, and for the insertion of oil burners to keep the surface of the steel hot In this way the metal is constrained to solidify from the bottom upwards, and not, as in the ordinary ingot, from the sides inwards. The ingots produced, weighing as much as 20½ tons, are, as would be expected, very free from axial unsoundness and fairly free from segregation. The height of the ingot is small compared with its diameter. For purposes of handling in forging, a stalk must be cast on to the ingot after it has just set. The mechanical tests given by such an ingot are distinctly better than those from a normal ingot of similar weight, particularly as regards specimens cut transversely. In the typical ingot discussed, with a height of 45 in and a diameter of 70 in, the typical V segregates of the normal ingot are absent, or shown only in a series of basin-shaped white markings on the sulphur print In this ingot the oil burners had been concentrated on the centre of the top surface, but since then better results have been obtained by arranging the burners around the sides of the mould.

Area-Computing Scale.—A useful device for computing the approximate area of plane figures of irregular shape is issued by Messrs G Cussons, Ltd, Technical Works, Manchester. It consists of a celluloid rectangle with graduated radial markings designed to give the required area in square inches to two decimal places As a substitute for Simpson's and other computing rules it should prove very serviceable in certain circumstances, since it needs only to be laid on the paper Special scale markings have been included to ensure full accuracy in limiting cases where this might otherwise be lost The instrument is stoutly made but transparent, whilst the markings are distinct and the figures clearly legible Explicit instructions for use, and easily grasped, are given in a circular accompanying the area-computing scale, and a number of illustrations are included The theory of the instrument has been given by Mr R W K Edwards in the *Proceedings of the Royal Society*, vol 73, and elsewhere

Effect of Nitrogen Peroxide on Combustion.—In vol 73 of the *Proceedings of the Manchester Literary and Philosophical Society* (1928–29), Prof. H. B Dixon and W. F. Higgins record further observations of the ignition temperatures of gases determined by their 'concentric tube' method whereby the influence of surfaces is practically eliminated The abnormal behaviour of ether vapour was confirmed, and a discovery of interest was the remarkable accelerative effect of small quantities of nitrogen peroxide on combustion, as shown by a considerable depression of the ignition temperatures of ether and hydrogen in air One part of nitrogen peroxide in 12,000 of air caused a depression of 30° in the value for ether in air; 1 part of nitrogen peroxide in 200 of air brought the ignition temperature of hydrogen down to 455°. These observations may be correlated with the recent observation of H W. Thompson and C. N. Hinshelwood that nitrogen peroxide in suitable small proportions accelerate the union of hydrogen and oxygen at temperatures just below ignition. They emphasise also the rôle of peroxides in accelerating combustion reactions of several types

Illumination in Buildings.—Article No. 18 of volume 19 of the *Scientific Proceedings of the Royal Dublin Society* deals with the measurements of the ratios of the illumination at various points within buildings to the illumination from the sky at points outside, made by Drs W R G. Atkins and H. H. Poole. The measurements were made by means of photoelectric cells and galvanometer deflections, so that they involve no visual comparisons of brightness. They are expressed in terms of the 'daylight factor,' that is, the ratio of the illumination of a small horizontal surface inside a room and outside where it receives light from the whole sky, but no direct sunlight The daylight factor in a well-lighted dwelling room is about 1 per cent, and close to a window may be 7 per cent. In an ancient church it sank to 0 2 as the mean value for about thirty different points, at some of which it was only 0 03. The authors point out that with such low factors it is not worth while to fit glass transparent to ultra-violet light in windows which do not receive direct sunlight.

Permian Diptera from Warner's Bay, N.S.W.

By Dr R J. TILLYARD, F.R S.

OF the myriads of species of insects which swarm upon this earth, none is of such absorbing interest to mankind in general as the two-winged flies grouped together in the great order Diptera. This order is, by common consent, admitted to be one of the most highly specialised within the class, if not actually *the* most highly specialised of all Yet, while no undoubted fossils of the order Lepidoptera, for example, are known older than the early Tertiary, definite, though somewhat obscure, dipterous types are known from the European Lias. We know, however, that the Lepidoptera must have existed for millions of years as obscure and very small types similar to *Micropteryx* and its allies, and that these in their turn had a common origin with the Caddis-flies or order Trichoptera. Ancient representatives of this latter order also occur so far back as the Lias, and I have previously given reasons why the common stem of the two orders Lepidoptera and Trichoptera must be regarded as having arisen from an extinct side-branch of the older order of Scorpion-flies or Mecoptera, which goes back, geologically, almost unchanged to the Lower Permian and probably also to the Upper Carboniferous

More recent researches into the origin of the Diptera indicate clearly two outstanding facts; (*a*) that they are, of all existing orders, the most closely allied to the Mecoptera, and (*b*) that they must have had origin from the Mecoptera by way of a type, or types, closely resembling the hypothetical common ancestor of the Lepidoptera and Trichoptera, but retaining the markedly mecopterous character of an unbranched first cubitus in the forewing, whereas this vein is always branched in the other two orders. A number of forms clearly belonging to this ancestral group, which I have elsewhere called the order Paratrichoptera, but which Dr Crampton prefers to call Protodiptera, were described by me from the Upper Trias of Ipswich, Queensland (*Proc. Linn. Soc N.S.W*, p. 199; 1919). Later on, through the discovery of the older insect fauna of Belmont, N.S W., of Upper Permian age, these forms were linked directly with the true Mecoptera by way of the two fossil genera *Belmontia* and *Parabelmontia*, which I placed in the new order Paramecoptera (*Proc. Linn Soc. N.S W*, p. 234; 1919; and p 286; 1922).

Fossil-hunting at Belmont has always been a very arduous task, because of the hardness of the rock and the extreme rarity of the fossils. A good average would be about one wing for three days' hard labour! Under such conditions it never seemed likely that a full knowledge of the Upper Permian insect fauna could be obtained. The late Mr. John Mitchell, who discovered these beds, had always in mind the possibility of finding an extension of them somewhere around the shores of Lake Macquarie. With the aid of Mr. T. H. Pincombe, he succeeded in exploring a number of localities with the same geological horizon, and finally they opened up the rich fauna of Warner's Bay, on the shores of the lake above mentioned.

The Upper Permian of Warner's Bay has now yielded several hundred specimens, most of which still await description. Apart from abundant Homoptera and two problematical remains of Odonata, the fauna is *entirely holometabolous*, consisting of the dominant order Mecoptera and the orders Paramecoptera, Neuroptera Planipennia, Protocoleoptera, and Coleoptera. The extensive representation of the order Mecoptera has brought to light so many new types that it is now found advisable to include the orders Paramecoptera and Paratrichoptera as suborders of that order, by means of a very slight extension of its accepted definition. *With this extension accepted*, it would be scientifically correct to state that the three orders Diptera, Trichoptera, and Lepidoptera *have been evolved from mecopterous ancestors*

The most interesting fact about the Warner's Bay Beds, as contrasted with the neighbouring Belmont Beds of the same age, is the abundance of very small insects. This is particularly noticeable in the Homoptera and Mecoptera In the latter order there are large numbers of tiny, fly-like Mecoptera, closely allied to the existing Australian family Nannochoristidæ. Some of these are practically complete specimens, and the more slender of them appear to have had hindwings in various stages of reduction, though their habit of dying with all four wings closely folded together makes the working out of the hindwing a very difficult task.

Bearing in mind the fact that four-winged Paratrichoptera are known to have lived in Australia right up to Upper Triassic times, while the oldest known true Diptera are Liassic, it did not seem very probable

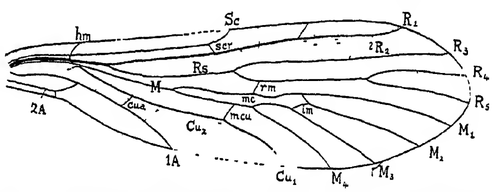

FIG 1—*Permotipula patricia* n g et sp Forewing Length 5 mm Upper Permian of Warner's Bay, N S W. Discovered by Rev A J Barrett, 1928

that we should ever discover true Diptera at Warner's Bay. But I have had the possibility in mind for some years, remembering that Protocoleoptera are found alongside true Coleoptera in the same beds, and Protodonata alongside true Odonata in the Lower Permian of Kansas Every small Mecopteron has been carefully studied in the hope of finding something more definitely dipterous than any hitherto known. But, until quite recently, the search was unavailing.

When I returned to Australia in October last, my friend the Rev. A. J Barrett, who had become interested in the Warner's Bay Beds, sent me a small parcel of fossil insects which he had found there Looking through these, I found the distal two-thirds of a small wing which seemed to me so obviously dipterous that I at once proceeded to study it in detail. To my great joy I found that both obverse and reverse impressions had been saved, and that in one of these the basal portion of the wing was covered by a small piece of rock. It is a risky matter to attempt to uncover hidden portions of fossils in this cherty shale; but I took the risk. A lucky stroke removed the overlying piece, and succeeded in exposing the complete wing, with only minor damage. To my astonishment, not only was this found to be truly dipterous, with an unexpectedly petiolate basal portion, but it must also be definitely classified as Tipuloid, and distinctly more advanced than such living forms as the Tanyderidæ, which have retained the original four-branched radial sector (*Rs*).

Fig. 1 shows this remarkable wing, which is just 5 mm. in length. The missing portions of the costa, apex, and posterior margin, and of the apical part of the first cubitus, are indicated by broken lines;

otherwise the wing is complete The wing is of the greatest interest, because any student of venation would certainly classify it as dipterous and nothing else, and yet *we do not know whether the insect to which it belonged had four wings or only two!* Also, it is the oldest known dipterous type of wing by many millions of years.

To facilitate discussion, it would be advisable to name the wing at once At Mr Barrett's request, I name it after my wife, as *Permotipula patricia* n g et sp. The wing must be classified in the superfamily Tipuloidea, in a new family Permotipulidæ characterised by the slight degree of petiolation, the short 2*A* and the elongate median cell (*mc*), and in a new genus *Permotipula* distinguished by the form of *Sc*, the positions of *rm* and *mcu*, the extreme narrowness and irregularity of *mc*, and the sessile origin of both median forks from that cell. A full analysis of the venational characters and a comparison with known archaic forms of Diptera will be published elsewhere The figure itself is sufficient diagnosis of the species

This discovery appears to indicate that the tendency towards lengthening and narrowing of the wings, which is marked enough to have been commemorated in the very name of the ancestral order, Mecoptera, ran to two successful specialisations. The first of these, the family Bittacidæ, retained all four wings, and so remains classified to-day as a family within the Mecoptera The second evolutionary effort, acting on much smaller and more insignificant types allied to the Nannochoristidæ, produced the true Tipuloid Diptera, or two-winged analogues of the Bittacidæ. From such small and obscure forms as the one now discovered, the great order Diptera must have originated, with all its multitude of new types, just as the even greater order Lepidoptera must also have originated from small and obscure types resembling *Micropteryx* and its allies. For a correct understanding of the larval forms of these two great orders, maggot and caterpillar alike, we must go back to the ancient polypod larva of the true Scorpion-flies.

The Department of Scientific and Industrial Research.

A PERUSAL of the Report of the Department of Scientific and Industrial Research for the year 1927–28 (Cmd. 3258 London: H M S O), which includes a summary review of the work carried out under the various research organisations of the Department during the year, will provide the reader with abundant evidence of the wide range of the activities and responsibilities of the Department The position of the research associations formed under the ægis of the Department is discussed elsewhere in this issue (p 749). The National Physical Laboratory and the Geological Survey have been for some years under the general direction and control of the Department; and there are between forty and fifty research boards and committees, dealing with such diverse subjects as chemistry, fabrics, engineering, metallurgy, physics, radiology, building, architectural acoustics, heating and ventilation, food, forest products, fuel, atmospheric pollution, national coal resources, water pollution, adhesives, dental investigations, gas cylinders, illumination, lubrication, and X-rays To attempt to give, in a reasonable allowance of space, a condensed compendium of what the report has to say on all, or even most, of these activities, is obviously impossible, and we must be content to select, more or less at random, some features of interest.

There are 36 pages devoted to a summary of the main features of the work of the nineteen research associations still in receipt of grant aid from the Department. The Wool Research Association has introduced this year a new woollen ring spinning frame which, it is claimed, is capable of producing two and a half times as much yarn per spindle as the standard frame, and of giving a superior yarn. It is the outcome of an exhaustive analysis by the latest scientific methods of the exact functions of every part of the existing 'Standard' machine; an analysis which showed clearly the directions in which simplicity could be effected without destroying practical efficiency. Reference is made to the new lead alloy introduced by the Non-Ferrous Metals Research Association as a result of investigations undertaken in co-operation with the Research Department, Woolwich. It has a strength, weight for weight, some 40 per cent greater than the ordinary commercial lead which is used for lead pipe, and, because of its freedom from the defect of a peculiar type of cracking, it is being used as a covering for electric cables The remarkable, but not surprising, statement is made that "the Association has hitherto failed, in spite of many efforts, to arouse any interest in it among manufacturers of lead pipe and sheet" This is but another instance of the many that could be given to illustrate the lag between the completion of a research and the application of its results to large-scale industrial practice

The report directs attention to the surprising statement in the inaugural address of the president of the Institution of Locomotive Engineers, in September 1927, that locomotive engineers have "not at their disposal any facilities for trying out experimental scientific research", and that there is no existing organisation in Great Britain which is available generally for the accurate testing of the performance and thermal efficiency of a locomotive. The Advisory Council, as the result of recent conferences on this subject, foreshadows the establishment of a national organisation for locomotive research.

On the subject of low temperature carbonisation the report states that "several processes are now being operated on a scale large enough to provide reliable data by which the possible limits of commercial success can be judged". A subsidiary company of the Gas Light and Coke Company, for example, is erecting plant to try out on a commercial scale the experimental retorts developed at the Fuel Research Station. Other investigations, connected with fuel research, to which brief reference is made, are those on metallurgical coke, which are being carried out by the Federation of Iron and Steel Manufacturers in co-operation with the Department; on the use of pulverised fuel in the mercantile marine; and on the economical use of coal

The Empire Marketing Board has provided a sum of £18,500 for the period up to Mar. 31, 1929, which has enabled the Director of Food Investigation to initiate a new programme of research on the preservation and transport of fish. Attention has been paid, in the first place, to those investigations likely to yield results capable of adoption by the existing fishing fleets, and, in particular, to an investigation into the possibility of landing in first-rate condition an increased proportion of the fish caught. "Preliminary investigations carried out during the summer of 1927 showed, rather unexpectedly, that the flesh of fish is not inherently of a highly perishable nature, but that, on the other hand, the natural rate of deterioration is profoundly affected by secondary environmental factors." Aberdeen has been selected

as the location of a research station for the fundamental researches needed.

In summarising the work done, and being done, on cement and concrete research, attention is directed to the fact that there are two main differences between concrete and steel, which are in themselves sufficient to account for the many anomalies observed by engineers when applying to concrete the standard methods of test to determine the strength of steel The first of these differences is the normal expansion and contraction of the material as the moisture in the surrounding atmosphere varies, and the second is the gradual flow of concrete under load Investigations on the measurement of adhesion stresses, and of stresses introduced in the steel of reinforced concrete by the shrinkage of cement, have been undertaken at the Building Research Station and "have already been productive of data of much importance"

Coming to the Department's activities that relate to what is usually called 'pure science', we may note that the grants for researches, research workers, and students for the year ended Mar 31, 1928, amounted to £31,346 net The grants made under this head during 1927-28 were in number 186, and the grants refused 118, as compared with 214 and 213 respectively for the previous year. The researches so assisted in the year under review include, among others, the work carried out by Sir William Bragg and his collaborators on the X-ray examination of materials; and investigations on magnetic phenomena by Dr. P. Kapitza and his collaborators.

Age-Hardening of some Aluminium Alloys.

SOME physical properties of five typical aluminium alloys containing copper, magnesium silicide, or both, have been examined by Dr. M. L V Gayler and G. D Preston, and the results were presented at the March meeting of the Institute of Metals. From this experimental work the following conclusions regarding the causes of the age-hardening of such materials are reached.

On prolonged annealing it is known that the precipitation of $CuAl_2$ or Mg_2Si, or both, depending on the composition of the alloy, occurs The changes of density which occur during ageing, together with the accompanying changes in the lattice parameter, suggest that a similar precipitation from the solid solution takes place during the earlier stages of this process. X-ray analysis shows that, in addition to the change of parameter, the crystals in the aged material are in a disturbed state which is gradually relieved as the heating is continued. This distortion of the space-lattice is accompanied by an increase of the electrical resistance and is believed to be caused by the formation of minute particles of the precipitated compounds. The precipitation of the dissolved substance from the supersaturated solution entails, first the rejection of the atoms of the dissolved metal from the lattice of the solid solution accompanied by the possible formation of molecules, a process which entails a profound disturbance of the lattice. In the second stage, which may follow closely upon the first and probably largely overlaps it, a 'coagulation' of these rejected atoms or molecules takes place, resulting in the formation of minute crystallites. This coagulation process, except perhaps in its earliest stages, by removing the dissolved metal from the matrix, will tend steadily to lessen the distortion of the lattice, and thereby to diminish the hardness and the electrical resistance.

It is interesting to note that if the age-hardening is due to the precipitation of a metal, and not a compound of that metal, the hardening effect is small, for example, the iron-copper alloys This would be expected on the basis of the theory outlined above, since it would cause less distortion of the lattice, no formation of molecules being required. If the formation of a compound involves the combination of atoms of the solute with those of the matrix, a greater distortion of the lattice will occur and the hardening be greater. When, however, the compound is formed by the combination of two or more different solute atoms, then still greater distortion is to be expected and marked increase of hardness results Thus the ageing of an alloy with 4 5 per cent of copper due to the formation of $CuAl_2$ is relatively much less than that of one with 1·08 per cent of Mg_2Si

Although up to the present the existence of lattice distortion has been inferred on general grounds, the new evidence from the X-ray spectra of aged alloys provides complete confirmation and shows, by the broadening of the lines, that this disturbance occurs to a marked extent which varies with the degree of hardness and electrical resistivity attained at the successive stages of the process. In the later stages of the ageing, when 'coagulation' has become appreciable and the precipitated substances have formed small distinct crystallites, the electrical resistance begins to fall again, the hardness diminishes, and the lines in the X-ray spectrum become less diffuse. F. C T.

University and Educational Intelligence.

CAMBRIDGE —Dr A B. Appleton has been reappointed University lecturer in anatomy, and Mr. G. E Briggs has been reappointed University lecturer in botany.

Grants have been made from the Gordon Wigan Fund to Prof. J. E Marr, Prof J. Stanley Gardiner, Mr. F T. Brooks, and Prof. J. Barcroft.

Dr. H R Dean, professor of pathology in the University, has been elected Master of Trinity Hall.

A Syndicate was appointed in May 1928 to report on the position of mineralogy in the studies of the University This Syndicate has now reported to the University, and has made the following recommendations:

(1) Two new departments should be created in place of the existing Department of Mineralogy, namely, a Department of Crystallography and a Department of Mineralogy and Petrology, (2) the Department of Mineralogy and Petrology should be closely associated with the Department of Geology, but should also work in co-operation with the Department of Crystallography, (3) the head of each of the new departments should be a professor, and the minimum additional staff of each department should be one lecturer and one demonstrator; (4) a new building should be erected for the Department of Mineralogy and Petrology adjacent to the Sedgwick Museum, (5) the premises of the existing Department of Mineralogy should be assigned to the new Department of Crystallography; (6) crystallography should become a subject in Part I. of the Natural Sciences Tripos, but should carry a smaller maximum of marks than the existing subjects; (7) mineralogy and petrology should form part of the subject of geology in Part I. of the Natural Sciences Tripos, either as an alternative to palæontology or in addition at the candidates' option, and that in the latter case mineralogy and petrology together should carry the same additional maximum of marks as that allotted to crystallography, (8) that both crystallography and mineralogy and petrology should be included in Part II. of the Natural Sciences Tripos, but that their relation to the other subjects, or to possible subdivisions of them, should be determined by the appropriate University bodies; (9) subject to the adoption of the above recommendations, the existing subject of

mineralogy in the Natural Sciences Tripos should be discontinued.

London.—Presentation Day at the University was on May 8, the ceremony taking place in the Albert Hall, the Vice-Chancellor, Sir Gregory Foster, presiding. The report of the Principal (Dr Franklin Sibly), the last to be presented under the old constitution, records continued progress The number of candidates for all examinations attained for 1928 a record of 34,941, comparing with 11,937 in 1913. This number includes 3383 candidates for first degrees and 508 for higher degrees, a total of 3891, of whom 2357 were internal and 1534 external. In the last year before the War, the numbers were 900 internal and 907 external. The roll of internal students now comprises 9886 names. Referring to the obligations of the Bloomsbury site, the Principal reported that four purposes had so far been approved—an administrative block, the Library, a Great Hall, and premises for the Union Society , in addition, eleven other purposes have been provisionally approved, including an Institute of Slavonic and East European Studies, towards which an offer of £35,000-£45,000 had been received and accepted from the government of Czechoslovakia, and provision for the teaching of the History of Art, for which Lord Lee of Fareham is collecting a fund.

The Vice-Chancellor, in welcoming the men and women who had become bachelors during the year, and those who had received higher degrees, appealed to the graduates to join Convocation and to use their voting powers when occasion arose. "These things", he said, "in the past had been left to a small minority." The University has a body of 170 professors, 80 readers, and about 830 recognised teachers. Next year the Union Society would have a Union House for the promotion of social life and the maintenance of their interest in University affairs. Referring to the new statutes for the University, the Vice-Chancellor said that the colleges and schools are now more closely federated with the University than before, and the symbols of this are the newly created Collegiate Council and the modification of the constitution of the Senate which has made it a more homogeneous body than hitherto ; and the growth of the financial responsibilities has involved the creation of the University Court to deal mainly with finance.

Mr. F. S. Marvin will be conducting a history course at Danzig in the first week of August and has secured the co-operation of several scientific workers as well as historians and those interested in international affairs, which should make the twelve lectures as useful and comprehensive as any that have preceded them in the 'Unity' series. The general topic is "The World of To-day", or "Progress in Ten Years of Peace". Mr. Marvin proposes to deal with general international relations since the War, and Rear-Admiral J. D. Allen, an expert on armaments and naval matters, will treat of that aspect of progress. Prof. Doris Mackinnon, of King's College, London, will lecture on "Where we stand in Biology", and Mr. L. L. White (author of "Archimedes", etc.) is coming from Berlin to speak on the position of the physical sciences. Other aspects will not be neglected and, as Danzig is a home of internationalism, it is hoped to secure the co-operation both of German and Polish speakers and listeners on education, art, and literature. The Baltic trip offers in itself great attractions to visitors, and is too little known in England. Danzig, to which passages may be booked direct from London, is the best centre. Full particulars may be obtained from the honorary secretary, Mrs. Innes, 29 High Oaks Road, Welwyn Garden City, Herts.

Calendar of Patent Records.

May 18, 1804.—Gas lighting has a well-authenticated history before the work of Frederick Albert Winsor, whose patent for an apparatus for making gas for lighting and heating was granted on May 18, 1804, but it was Winsor who first advocated the public use of gas lighting, and its supply and distribution from a central source Pall Mall was lighted by him in 1807, and the forerunner of the Gas Light and Coke Co. was formed a few years later.

May 20, 1800.—An early reaping machine was that for which a patent was granted to Robert Meares on May 20, 1800 A large pair of shears is fitted to a frame mounted on wheels. Long handles are fitted to the shears and by these the apparatus is propelled and the shears operated Wires are arranged to guide the fall of the crop as it is cut

May 22, 1813.—William Brunton's 'steam horse' for propelling or drawing carriages upon roads or railways by means of levers or legs worked by a steam engine and acting alternately or conjointly against the ground, was patented on May 22, 1813. The engine worked successfully on the Newbottle colliery tramline and drew coals up an incline of 1 in 36, but was eventually wrecked by an explosion.

May 22, 1834—Baron Heurteloup patented on May 22, 1834, a self-priming gun in which a long tube of detonating powder was contained in the stock and was moved forward into position by each fall of the hammer. The hammer cut off the fragment of the tube required and then detonated the powder. In 1836 Heurteloup petitioned the Privy Council for a confirmation of the patent as he had discovered that a similar arrangement had been previously patented in France in which a straw filled with detonating powder was used, though the action was different, the gun was not self-priming, and the patent had apparently never been put into practice. The petition was granted and the patent confirmed.

May 22, 1847.—Sydney Smith of Nottingham solved the problem of the safe application of steam power by inventing and making the first efficient steam-pressure gauge, the steam acting on a flexible diaphragm connected through mechanism with the needle of a dial. The patent is dated May 22, 1847.

May 23, 1829—The accordion—the intermediate between the mouth-organ and the concertina—was the subject of the Austrian patent granted on May 23, 1829, to Zyrill Demian and his two sons Karl and Guido, organ makers of Vienna. The patent was originally for two years only, but was extended for another three years in 1831.

May 24, 1834.—The chain-grate mechanical stoker was first devised by John George Bodmer, and was included with other forms of the mechanical stoker in his patent No 6616, sealed on May 24, 1834. Bodmer described in his specification apparatus of the endless-chain type, but his preferred form consisted of a number of separate carriages which were intermittently pushed forward and one by one discharged at the back end, to be returned rapidly to the front and fed with fresh coal for another passage through the furnace. It was left to John Juckes, seven years later, to perfect the endless-chain type and introduce it into industry.

May 24, 1847.—The fish-plate joint now in universal use for the rails of railways was invented by W. Bridges Adams, and was patented by him and Robert Richardson on May 24, 1847 Until its adoption, rails were butt- or lap-jointed together in wide chairs.

Societies and Academies.

London

Royal Society, May 9 —**R. H Fowler** and **P. Kapitza** Magnetostriction and the phenomena of the Curie point. Various physical consequences of Heisenberg's theory of ferro-magnetism are discussed. The phenomena require the interaction integral, called by Heisenberg J_0, to increase with the volume of the crystal at least over a small range of value, covering the normal value for iron —**C. G. Darwin** A collision problem in the wave mechanics In the quantum theory the motion of matter can be regarded as a wave motion, but this motion is interpreted in terms of particles in order to describe what is observed In an ideal experiment of this kind depending on collisions between two free bodies, the particle-like behaviour is given just as successfully by the wave theory. Thus the interpretation can sometimes be postponed.—**J A. Gaunt** The relativistic theory of an atom with many electrons. The total angular momentum of the atom, suitably defined, has the same properties as in the non-relativistic theory The inner and magnetic quantum numbers, and their selection rules, can therefore be taken over into the new theory.—**R. de L. Kronig** The quantum theory of dispersion in metallic conductors.—**N. F. Mott**: The interpretation of the wave equation for two electrons As required by the relativistic equation proposed by Eddington, the results of the two separate experiments required to locate each electron are independent.—**G I Taylor**. The criterion for turbulence in curved pipes Coloured fluid is introduced through a small hole in the side of a glass helix through which water is running. C. M White's conclusion from resistance measurements, that a higher speed of flow is necessary to maintain turbulence in a curved pipe than in a straight one, is verified —**H. J. Phelps** and **R. A. Peters** The influence of hydrogen ion concentration on the absorption of weak electrolytes by pure charcoals. Hydrogen ion concentration influences adsorption upon purified charcoal of various organic acids and bases and of some amino acids in varying degrees, sometimes showing a relationship to the degree of ionisation.—**R. K. Asundi**: The third positive carbon and associated bands. The third positive carbon bands, the 3*A* bands and the so-called Wolter spurious bands, have been photographed. A complete vibrational analysis of the three systems shows that they have the same final electronic state —**F. J Wilkins**: The kinetics of the oxidation of copper (1).—**C. E. Eddy, T. H. Laby,** and **A. H. Turner**: Analysis by X-ray spectroscopy.—**M. C. Johnson**: The adsorption of hydrogen on the surface of an electrodeless discharge tube.—**A. Elliott**· The absorption band spectrum of chlorine —**H. W. Thompson** and **C N. Hinshelwood** The influence of nitrogen peroxide on the combination of hydrogen and oxygen —**H T. Flint**· The first and second order equations of the quantum theory —**S. Bhagavantam**. The magnetic anistropy of naphthalene crystals —**A. H. Wilson**. Perturbation theory in quantum mechanics (2).—**C G. Lyons** and **E. K. Rideal**· On the stability of unimolecular films (1, 2, and 3) —**P. A. M Dirac**: Quantum mechanics of many-electron systems —**O. W. Richardson** and **P M. Davidson**: The spectrum of H_2. The bands analogous to the parhelium line spectrum (3 and 4) —**H E. Hurst**· The suspension of sand in water —**D. Brunt**: The transfer of heat by radiation and turbulence in the lower atmosphere —**W. G. Bickley** Hydrodynamic forces acting on a cylinder in motion, and the idea of a 'hydrodynamic centre'.—**M L. E. Oliphant** The action of metastable atoms of helium on a metal surface —**J. Hargreaves**: The effect of a nuclear spin on the optical spectra.—**M. N. Saha** and **Ramash Chandra** New methods in statistical mechanics

Linnean Society, April 18 —**G. Claridge Druce**. A botanical tour in Cyprus. The botanical history of Cyprus is a long one. Theophrastus mentions some of its products, Dioscorides alludes to its Origanum oil, and Drummond in 1754 was the first to record a definite endemic species, *Quercus alnifolia*; a second, *Onosma fruticosum*, was found by Labillardière in 1787, *Putoria* and the *Cedrus* had also thus early been noted Its true scientific exploration was began by Sibthorp in 1787 accompanied by his artist, Bauer, the discoverer of *Pinguicula crystallina*. The new species were published chiefly by Boissier. T Kotschy visited the island three times between 1840 and 1862 and brought up the number of species to 1050. Mr A. Lascelles (now Sir Alfred), when he was judge there, and his sister, Miss Lascelles, made considerable collections in 1900–2 The author verified some of the earlier records and added *Lamprothamnium papulosum* J. Groves, a great extension in the north-east. —**G. S Carter** and **L. C. Beadle**. Respiratory adaptations among fishes of the swamps of the Paraguayan Chaco. As previously shown, the fauna is normally exposed to great lack of oxygen. The fishes may obtain a further supply of oxygen from the well-oxygenated surface-film of the water, and the air above the water. Of the twenty species collected in the swamps, eight breathe air and the remainder make use of the surface-film by means of accessory organs. Most of the excretion of carbon dioxide is carried on in the gills, but the absorption of oxygen takes place almost entirely in the accessory organ This is due to the evolution of the accessory organs for life in a medium poor in oxygen, and not for migration out of the water. It is suggested that in the evolution of the vertebrates, aerial respiration was evolved in waters of this type as an adaptation to lack of oxygen while the fish was purely aquatic, and that this development opened the way to the later changes definitely associated with the migration.

Brussels

Royal Academy of Belgium, Oct 13 —**P. Stroobant**: The meeting of the International Astronomical Union at Leyden, July 5–13, 1928 A general account of the work done at the meeting —**D. V. Jonesco**: A theorem of Lord Kelvin (2) —**Victor Van Straelen** The triassic crustacean decapods and the origin of a phylum of Brachyura.—**Henri Fredericq** The chronaxy of the muscles of insects. From the measurements given, the motor muscles of the wings of the dragon fly, humble-bee, and blowfly must be considered as organs of moderately rapid function This idea, which is in contradiction with accepted ideas, can be explained, with Jarolimek, if it is admitted that these muscles do not act directly on the wing —**Henri Fredericq**· The chronaxy of the invertebrate heart (cephalopods and decapod crustaceans) The bathmotrope action of the visceral nerves of the octopus.—**J. E Verschaffelt**· The determination of surface tension by the method of separating discs A discussion of the theory of the method and experimental figures for water, benzene, nitrobenzene, carbon tetrachloride, and aniline —**E. Delporte** Discovery and observations of minor planets at the Royal Observatory of Uccle.—**Em. Vincent**: Observations on the layers penetrated at the No 2 pits of the Eysden coal-pit, near Maaseyck. —**Armand Duchesne**: The influence of the thermometer mass on the measurement of a constant tem-

perature or of one varying with time Experiments are described which support the contention that the temperature of a superheated vapour or of a gas can only be measured accurately with a thermometer of negligible mass

Nov. 3 —**P. Stroobant** A new calculation of the flattening of Saturn —**E. Delporte** · Discoveries and observations of minor planets at the Royal Observatory of Belgium.—**Henri Fredericq** . The action of the faradisation of the nearer portions of the ganglion nerve chain of the lobster on the chronaxy of the distant portions —**Victor Van Straelen** . A new prosopon from the Diois Hauterivian and the Cretaceous 'Dromiacea' in general.—**D. V Jonesco** . A theorem of Lord Kelvin (3)

LENINGRAD.

Academy of Sciences (*Comptes rendus*, 1929, No. 1) —**S. Kostytschew and V. Berg** : The forms of calcium compounds in vegetable tissues. The bulk of calcium in vegetable tissues is in the form of salts, mainly of oxalic, phosphoric, and carbonic acids ; some of it is in complex combinations with organic substances, or in the form of salts absorbed by the colloid substances of the protoplasm No difference in the forms of calcium compounds found in leaves and in the organs devoid of chlorophyl was found —**N. Gutkova** A mineral of the keffekilite group from the Tertiary deposits of the Crimea —**A. N. Kiritshenko** · Contribution to our knowledge of the genus *Aphelochirus* (Hemiptera, Naucoridae) A list of 22 species of the genus is given and their distribution indicated on a map. Two new species, *A. improcerus* from Manchuria and *A. ussuriensis* from the Ussuri-land, are described and figured —**I. Efremov** · Finds of stegocephals in the north-east of European Russia Four distinct places where fossil remains of stegocephals are found are described in detail —**A. P. Filippov** : Deformation of elliptic plates with supported margins —**T. Ščegoleva-Barovskaja** The first representative of the family Mordellidæ (Coleoptera) from the Jurassic deposits in Turkestan A new genus and species, *Præmordella martynovi*, representing a new subfamily Præmordellinæ is described

ROME.

Royal National Academy of the Lincei, Feb. 3.—**G. D'Achiardi** : Mode of formation of mimetic groups of dachiardite. This mineral, found in the geodes of one of the pegmatitic veins traversing the granite of Monte Capanne, near S Piero in Campo, Elba, was termed mimetic zeolite, from its composition and from its occurrence in apparently octagonal prisms formed by the union of eight crystalline individuals. The pseudo-prismatic groups have an upper funnel-shaped end, either closed or open at the centre The origin of this structure is discussed.—**L. Petri** · Behaviour of the olive under the influence of uranium radiations and of ionisation of the air. The stimulating action of ionised air on the growth of the olive is neutralised by the radiations emitted by the green oxide of uranium, when these exceed in intensity a certain limiting value.—**G Vitali** . Bianchi's identity for Riemann's symbols in generalised absolute calculus —**A. Signorini** . Electrostatic interpretation of the Kutta-Joukowski theorem.—**L. Fantappiè** Functional operators and calculation of infinite matrices in the quantum theory (2) By means of the notion of a symmetrical or hemisymmetrical functional product and, in general, of the notions of the theory of analytical functionals, it is possible not only to replace all the symbolic formations (mostly divergent series) used in the calculus of matrices due to Heisenberg, Born, and Jordan, by so many integral formations of well-defined significance, but also to reduce the whole matrix calculus to the calculus of symmetrical composition of the functions of two variables co-ordinated to the matrices themselves —**A De Mira Fernandes**: Superficial transports —**Silvia Martis in Biddau** · Investigation of a rational expression for the powers of a matrix of the third order —**Ines Sacilotto** : Riemann symbols in generalised absolute differential calculus. — **B Colombo** · Certain theorems regarding the generalised transformations of Darboux —**A. Carrelli** Broadening of bands by resonance (1) The causes for the broadening of spectral lines are numerous When, for example, the concentration of sodium atoms is diminished, the effect of resonance becomes annulled, but the pressure or Stark effect begins to preponderate, this effect being proportional, not to the number of atoms of the same kind, but to the total number of atoms or ions of any kind present in the flame. Moreover, when the concentration is extremely small, the line, although having zero breadth from the Holtzmark effect or the effect of pressure, has a finite breadth by auto-extinction or by the Doppler effect, and hence there should be a zone of values for the concentration in which anomalies in behaviour foreseen by Holtzmark become apparent Such a zone may be readily realised experimentally —**M Amadori**. Condensation products of glucose and *p*-anisidine Like *p*-phenetidine, *p*-anisidine condenses with glucose, giving two products, one, melting at 86°, having a glucosidic constitution, and the other, melting at 140°, the constitution of a Schiff's base.—**G. Malquori** : Conductivity of mixed solutions of lead and ammonium nitrates. The formation of complex compounds, assumed to be a probable cause of the solubility relations of solutions containing lead and ammonium nitrates, is confirmed by a study of the electrical conductivities of such solutions.—**A. Tulli** Chemical analysis of a mummy : contribution to the study of mummification. Examination of a mummy from the Vatican Museum which, although bearing an inscription indicating it to be that of a lady of noble birth, was that of a man, points to the use of natural balsams in the mummifying process —**Maria Bergamaschi** Absorption of carbon dioxide by means of roots, and its utilisation in chlorophyllic synthesis The results of experiments on maize and other plants show that plants grown in an atmosphere absolutely devoid of carbon dioxide form starch in their leaves by utilising the carbon dioxide absorbed by their roots from the soil or from the nutrient solution surrounding the roots Plants grown in this way from seeds contain a greater amount of carbon than the seeds themselves, and are, therefore, able to 'organicise' carbon dioxide absorbed through the roots. The objection that, in such cases, the organic substance is formed entirely at the expense of the carbon dioxide furnished by respiration is thus refuted. These results are of both physiological and practical importance, and indicate the value of supplying carbon dioxide to the roots as well as to the leaves.—**G. Quagliariello** . Investigations on the mechanism of lymph formation. The differences in chemical constitution and in chemico-physical properties between lymph and plasma may be explained to some extent by assuming that, between the two liquids separated by a membrane far more permeable to electrolytes than to colloids, there is a tendency to the establishment of a membrane equilibrium. It is not, however, contended that the relationship between blood and lymph is completely represented by a simple system of this kind, as it is recognised that lymph is formed, not only from the blood but also from the tissues, which may be able to withdraw from the lymph one element in preference to another.

Official Publications Received.

BRITISH

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1168 (Ae 332) Experiments on a Model of the Airship R 101 By Dr R Jones and A H Bell (T 2304) Pp 27+7 plates (London H M Stationery Office) 1s 3d net

Cambridge Natural History Society Fauna List No 2 The Spiders of Cambridgeshire (including Harvest Spiders and Pseudoscorpions) By W S Bristowe Pp 25 (Cambridge)

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society Edited by H Munro Fox Vol 4, No 2, April Pp 103-208 (Cambridge At the University Press) 12s 6d net

Hull Museum Publications No 155 Record of Additions Edited by T Sheppard Pp 24+8 plates No 156 Oil Seed Crushing By T Sheppard (Commercial Museum Handbooks, No 3) Pp 10+4 plates No 157 Record of Additions Edited by T Sheppard Pp 50 (Hull)

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1928, presented to the Annual Meeting, February 11th, 1929 Pp 41+13 (York)

Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No 41 Studies concerning the so-called Bitter Pit of Apples in Australia, with special reference to the variety "Cleopatra" By W M Carne, H A Pittman and H G Elliot Pp 101 (Melbourne H J Green)

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1196 Report on Progress during 1927-28 in calculation of Flow of Compressible Fluid, and Suggestions for Further Work By Prof. G I Taylor (T 2654) Pp 18+3 plates (London H M Stationery Office) 1s net

Memoirs of the Asiatic Society of Bengal Vol 9, No 5 Geographic and Oceanographic Research in Indian Waters Part 5 Temperature and Salinity of the Surface-Waters of the Bay of Bengal and Andaman Sea, with references to the Laccadive Sea By Lieut-Col. R B Seymour Sewell Pp 205-355 (Calcutta) 5 10 rupees.

Publications of the South African Institute for Medical Research No. 23 A Mosquito Survey of certain Parts of South Africa, with special reference to the Carriers of Malaria and their Control (Part 2) By Dr Alexander Ingram and Botha de Meillon Pp 83-170+10 plates (Johannesburg)

The Quarterly Journal of the Geological Society Vol 85, Part 1, No 337, April 19th Pp xlviii+108+10 plates (London Longmans, Green and Co, Ltd) 7s 6d

FOREIGN.

Scientific Papers of the Institute of Physical and Chemical Research No 182 Researches on the Piston Ring By Keikiti Ebihara Pp 107-185 1 20 yen No 183 The X Ray Diffraction Haloes in the Aqueous Solutions of Electrolytes By Hikoichi Shiba and Tokunosuke Watanabe. Pp. 187-192 20 sen No 184 A Study of the Helium Band Spectrum By Sunao Imanishi Pp 193-209 25 sen No 185 Non-Consumption of Vitamin B by growing Chicken Sarcoma By Waro Nakahara and Eiichi Somekawa. Pp 211-220 25 sen. (Tōkyō Iwanami Shoten)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 81. Studies in Malayan Blattidae (Orthoptera) By Morgan Hebard Pp 109+6 plates (Philadelphia.)

Bulletin of the American Museum of Natural History. Vol 58, Art 6 The Parasitic Worms collected by The American Museum of Natural History Expedition to the Belgian Congo, 1909-1914 By Horace W Stunkard Pp 233-289 (New York City)

The Danish *Dana* Expeditions, 1920-1922, in the North Atlantic and the Gulf of Panama Oceanographical Reports edited by the *Dana* Committee No 3 Contribution to the Hydrography of the North Atlantic, the *Dana* Expedition 1921-22 By J P Jacobsen Pp 98 (Copenhagen Gyldendalske Boghandel, London Wheldon and Wesley, Ltd) 12s

Smithsonian Institution United States National Museum Bulletin 100 Contributions to the Biology of the Philippine Archipelago and adjacent Regions The Fishes of the Series Capriformes, Ephippiformes, and Squamipennes, collected by the United States Bureau of Fisheries Steamer *Albatross*, chiefly in Philippine Seas and adjacent Waters By Henry W Fowler and Barton A Bean Pp. xi+352 (Washington, D C Government Printing Office) 60 cents

CATALOGUES.

Nickel Cast Iron Series B, No 5 Nickel Cast Iron By Prof D Hanson Pp 12. (London The Bureau of Information on Nickel, Ltd)

Chemical Apparatus Laboratory Apparatus, Machinery and Equipment for all branches of Educational Research and Industrial Chemistry, Chemicals and Reagents, Scientific and Technical Books (Catalogue No 12A) Pp xvi+990 Microid Pyrometers (Catalogue No 20T) Pp 44 (London and Glasgow Griffin and Tatlock, Ltd)

Diary of Societies.

FRIDAY, MAY 17.

ROYAL SANITARY INSTITUTE (at Town Hall, Devizes), at 5 30—R T Rhodes and others Discussion on The Milk and Dairies Order, 1926—L. B Densham and others Discussion on Meat Inspection

ROYAL PHOTOGRAPHIC SOCIETY (Pictorial Group, Practical Meeting), at 7

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section) (Annual General Meeting), at 8—Dr. H R. Spencer A Straight Rod Pelvimeter—G I Strachan Some Contraindications to Radiotherapy in Carcinoma of the Uterus—V Bonney Results of the Surgical Treatment of Carcinoma of the Uterus

SATURDAY, MAY 18

ROYAL SANITARY INSTITUTE (at Town Hall, Devizes), at 10 A M—H R Hooper and others Discussion on Some Aspects of Local Government on Air, Water, and Sewerage—A W Jakeway and others Discussion on The Devizes Sewage Works and Small Type Refuse Destructor

MONDAY, MAY 20

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Cavendish Laboratory), at 4 30—Dr H Jeffreys On the Transport of Sediments by Streams—Dr B F J Schonland A New Electroscope—J Hargreaves (*a*) The Dispersion Electrons in the One Electron Problem, (*b*) Some Calculations Relevant to the Quantum Defect in the Extended Ritz Formula—S E A Landale An Analysis of Triode Valve Rectification—*Papers to be communicated by title only*—J A Chalmers An Approximate Method of Determining the High-Velocity Limits of Continuous β-ray Spectra—L Roth Jacobian Surfaces of Quadrics in Four Dimensions—L Rosenhead Systems of Double Rows of Line Vortices in a Channel of Finite Breadth where the Axis of the Row is Parallel to the Axis of the Channel—J R Wilton On Ramanujan's Arithmetical Function $\Sigma_{r,s}(n)$—P L Srivastava On the Phragmén-Lindelof Principle—Dr A C Dixon The Second Mean Value Theorem in the Integral Calculus—R A Frazer A Proof of Miquel's Theorem by Involutions in the Argand Diagram

WEDNESDAY, MAY 22

ROYAL SOCIETY OF MEDICINE (Comparative Medicine Section), at 5—Annual General Meeting

EUGENICS SOCIETY (at Linnean Society), at 8—Dr R A Fisher, Prof T E Gregory, and others Discussion on Are Family Allowances Eugenic in Effect?

INSTITUTION OF WATER ENGINEERS (at Birmingham)

THURSDAY, MAY 23.

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemistry Lecture Theatre, Royal College of Science), at 5—Prof R Robinson The Chemistry of the Indole Group

INSTITUTE OF PATHOLOGY AND RESEARCH (St Mary's Hospital), at 5—Prof W W C Topley The Natural Acquirement of Immunity

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30—F A Foord Lubrication of Aircraft Engines

FARADAY SOCIETY (Annual General Meeting) (at Chemical Society), at 7.45—At 8—J C Hudson Third (Experimental) Report to the Atmospheric Corrosion Research Committee of the British Non-Ferrous Metals Research Association

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8 30—Annual General Meeting

INSTITUTION OF WATER ENGINEERS (at Birmingham)

FRIDAY, MAY 24

LINNEAN SOCIETY OF LONDON (Anniversary Meeting), at 5—Presidential Address and Presentation of Linnean Gold Medal to Prof H de Vries

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (Annual General Meeting), at 5—Dr F J Poynton Some Phases in English Pediatrics as viewed by a General Physician

PHYSICAL SOCIETY (at Imperial College of Science), at 5—Dr Ezer Griffiths A Hygrometer for Use in Timber Seasoning Kilns.—Dr J H Vincent Experiments on Magneto-striction Oscillations at Radio-Frequencies

ROYAL INSTITUTION OF GREAT BRITAIN, at 9—F J Rennell Rodd The Tuareg Tribes of Central Sahara

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland and Glasgow Sections) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland and Glasgow Sections) (at Glasgow)—Prof G G Henderson · Recent Research in the Terpene Series

INSTITUTION OF WATER ENGINEERS (at Birmingham)

SATURDAY, MAY 25

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland and Glasgow Sections) (at Glasgow)

CONFERENCE.

MAY 18 TO 21.

ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS (at Liverpool).

PUBLIC LECTURES.

TUESDAY, MAY 21

UNIVERSITY COLLEGE, at 5 30—Dr R Flower Life, History and Folklore of a Kerry Island (Succeeding Lectures on May 28, June 4 and 11)

THURSDAY, MAY 23

UNIVERSITY COLLEGE, at 2 30—Sir Flinders Petrie Recent Discoveries at Beth-Peleth, Palestine (Lecture to be repeated on May 31, at 5 30 and on June 1, at 3)

UNIVERSITY OF BIRMINGHAM, at 4—Dr H C Cameron Some Types of Septic Infection in the Newly-born (Ingleby Lectures) (Succeeding Lecture on May 30)

FRIDAY, MAY 24

BIRKBECK COLLEGE, at 5 30—Prof S de Geer Sweden and the North of Europe (Succeeding Lectures on May 28 and 30)

SATURDAY, MAY 25, 1929.

CONTENTS.

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Competition and Progressive Industry.

COMPETITION in a general sense is easily defined, and the dictionaries are fairly clear and consistent in their meaning. In the strictly economic sense also there has hitherto been little difficulty. The American economist Walker, for example, is very precise and definite in his description of the essential nature of competition. Competition, he says, signifies the operation of individual self-interest among the buyers and sellers of any article in any market. It implies that each man is acting for himself solely, in exchange, to get the most he can from others, and to give the least he must himself. Competition is opposed to combination in any form, to custom, and to sentiment, even though these, especially the two latter, in actual business have always played a part.

No one to-day believes, however, in the possibility of pure and unalloyed competition, wholly unrestrained and unregulated. Not only does it exist, of itself, in many varied forms and manifestations, but also it has been profoundly affected by the introduction of ethical and moral considerations, many of which have acquired the force and status of law. Moreover, other great forces have sprung into existence and rapidly developed of late years, such as co-operation and combination, the formation of trusts and cartels and of vast international conglomerations, whereby the original conception of competition has either been pushed entirely into the background or has been transformed beyond recognition. The question is thus raised in an acute form. What is the real essence and purpose of competition in industry to-day? What part, if any, does it seem destined to play in the future? Can it be reconciled and fit in with the new changes and new forces, or is it being transformed out of existence?

Much confusion of thought on these questions arises from the divergent views held in regard to industry itself and its proper place in the scheme of things. The socialist attitude, for example, towards competition will be very different from that of the individualist; and again, those who disbelieve in industrialism altogether will certainly entertain the utmost loathing for competition, the most powerful instrument of progress. It is therefore necessary, at the outset, to make a philosophical distinction, and decide whether we believe in progress or not, whether we have a profound faith in the Baconian philosophy of 'fruit' or in the Diogenic doctrine of the tub, with its reduction

of wants and satisfactions to a minimum It is not necessary at this time to deal with the larger question of progress and its would-be philosophical critics, or to frame an elaborate apologetic of modern industry It will be taken for granted that progress, with all its errors and blind gropings and possibly mistaken ideals, is desirable and indeed inevitable, that it is not necessarily soul-deadening materialism, but can be made subservient to the highest intellectual and moral interests and activities of mankind It will be shown that competition can play a vital and increasingly nobler part in that progress.

In regard to the socialist attitude, it is of interest to quote J. Stuart Mill's incisive condemnation thereof—and he, of all men, cannot be charged with undue harshness to the socialists. He says

"I utterly dissent from the most conspicuous and vehement part of their teaching, their declamations against competition With moral conceptions in many respects far ahead of the existing arrangements of society, they have in general very confused and erroneous notions of its actual working, and one of their greatest errors, as I conceive, is to charge upon competition all the economical evils which at present exist. They forget that wherever competition is not, monopoly is; and that monopoly in all its forms is the taxation of the industrious for the support of indolence, if not of plunder . . Instead of looking upon competition as the baneful and anti-social principle which it is held to be by the generality of Socialists, I conceive that, even in the present state of society and industry, every restriction of it is an evil, and every extension of it, even if for the time injuriously affecting some class of labourers, is always an ultimate good. To be protected against competition is to be protected in idleness, in mental dullness; to be saved the necessity of being as active and intelligent as other people."

This no doubt is far too sweeping, and, while showing up the error of the socialist view, commits serious blunders of its own Every restriction of competition is not of course necessarily an evil, nor is every extension thereof an ultimate good, nor is every form of monopoly always evil In fact, neither Mill nor the socialists have found the real truth Both competition and monopoly require proper regulation and control, when both may be highly beneficial. It is not indeed by any means certain that unrestrained monopoly is a greater social evil than unrestrained competition, though strangely enough, and through a most remarkable form of mental aberration, free competition has been held by some, for example, the framers of American anti-trust legislation, to be sacrosanct and above reproach, whilst monopoly has been anathematised as everything that is bad Under the latter misguided view the whole basis of patent law, among other things, is thoroughly wrong and unsound. But a full discussion of monopoly and all its implications must be deferred.

In its natural and original sense competition means the struggle for existence, issuing in the survival of the fittest It dominates biology and the theory of evolution, and when Herbert Spencer applied evolutionary doctrine to social phenomena it was taken over almost in its entirety—with all its crudeness and cruelty—by the economists, at least for a time Huxley seems to have been among the first to see that this was going much too far. He realised the necessary checks to the full force of competition which must be imposed by the social framework within which it acts "Social progress", says Huxley, "means a checking of the cosmic process [of ruthless competition and struggle] at every step, and the substitution for it of another which may be called the ethical process; the end of which is not the survival of those who may happen to be the fittest in respect of all the conditions which exist (environment), but of those who are ethically the best" Thus an ethical aspect was introduced, and thus incidentally we see also that the question, Who are fittest to survive? to which reference will be made later, is involved.

Prof. Gide's definition is: When each individual is at liberty to take the action he considers the most advantageous for himself, whether as regards the choice of an employment or the disposal of his goods, we are living under the regime of competition But this takes too much for granted and lacks precision, for, strictly speaking, robbery with violence, or piracy, or fraud and cunning, are not excluded. It is therefore clear that competition must keep within the law, most of which—written and unwritten—can be summed up in the good old sporting phrase, "Play the game, and take no mean advantage of a rival". Moreover, we no longer believe in the blind uncontrolled evolution of society. We believe it is possible to set definite aims before us, for example, in regard to race improvement and the ultimate attainment of the highest type of manhood. No longer is everything to be sacrificed to the accumulation of wealth; we place man first; and with this profound change in aim there is a change in the rules of competition. Slavery has been abolished; piracy does not now figure in honourable competition; the labour of young children is condemned, the hours of work of adult men and women have been reduced. The

cruelties of the cosmic struggle are being constantly mollified by rising ethical and moral standards. What may be called the 'plane of competition' has been raised to loftier heights, and much has been left behind and below in the process Piracy and all that it means, the arbitrament of force and cunning, has fallen outside of and below that rising plane, and has been replaced by other mighty forces working strongly for social betterment Of these forces, co-operation, *or the enlargement of the competitive group*, is among the greatest.

At first sight it would appear that increasing co-operation means decreasing competition, but this is probably a superficial misconception There has been co-operation from the beginnings of things. Even among animals, with the struggle for existence at its keenest, there is, nevertheless, a certain amount of mutual agreement and help among the members of a group or community. What has happened in modern times, with growing co-operation, is a difference in degree rather than in kind : the competitive group has become larger, and new groups have been formed. This coalescing into groups, political, economic, scientific, and the like, is one of the most characteristic phenomena of modern society, and its reaction on competition is of profound interest. One of the results so far is an infinite variety of competitive groups, and although the competition, as between different groups, may be keener than ever, it is also cleaner, and the effect on an individual is softened and modified, not only by association with others in the group, but also by a rising tide of sympathy, benevolence, and public humanitarianism expressed both through law and custom; and the group is thereby strengthened. Darwin realised this clearly enough. He says :

> " Animals endowed with the social instincts take pleasure in one another's company, warn one another of danger, defend and aid one another in many ways. These instincts do not extend to all the individuals of the species, but only to those of the same community. As they are highly beneficial to the species they have probably been acquired through natural selection."

In human affairs, however, the groups are getting larger, are reaching out rapidly to international dimensions This is a stern fact of our times, and we see not as yet clearly whither it will lead us, or how it will end. It is the greatest and most perplexing problem of the age. But one thing at least seems perfectly clear. If we take for examination any one particular group, say, a trade union of workers in any one industry, do we not see that the grand idea of co-operation is not necessarily antagonistic to or mutually destructive of competition , that competition, in one very important direction, may be retained in full force, namely, *in the terms of admission to the group*? Membership of a group in most professions, and formerly in the old trade guilds, is or was a guarantee of a certain standard of workmanship and character It is surely in the best and highest interests of a group or union to maintain a high standard. It would still be possible to permit of several grades within the group, and the good workman should not be penalised and brought down to the level of the inferior, or the latter unduly bolstered up to heights beyond his deserts. As we have already seen, even J. Stuart Mill would allow no weak sentiment, no excess of humanitarian zeal, to thwart the exercise of this salutary principle.

In regard to another important manifestation of industrial grouping, namely, that of the trust and international combine, and its effect on competition, it is only possible to refer here very briefly to one or two points. It is now generally agreed that complete monopoly is very difficult of achievement, and even if achieved it must be subject to control by the State But the form of control, as the Federal Trade Commission of the U.S A. has found, presents great practical difficulties. The combine itself, however, and also the trade association, is finding that, in its own best interests, it must put service to the public before exploitation, and that control should be exercised so far as possible from within rather than imposed from without Hence it is that there is now much talk of ethical rules and standards by trade associations, especially in the U S A , and that unfair methods adopted by any member should justify the expulsion of that member from the group Here again the competitive principle may be applied in the selection of the right men to control the destinies of the group, and perhaps also by the imposition of certain conditions and standards of membership. This also applies to the co-operative societies in all their manifold forms

It is being increasingly realised, even by the most powerful combine, that trade is healthiest and most flourishing when built up, not on selfish aggrandisement but on service, good quality, and moderate prices ; and those groups are 'fittest to survive' who take their stand on these adamantine foundations. Competition of the right kind is still the mainspring of progress, but it is constantly rising to higher levels, and implies worthy struggle for the things that matter.

History of Biology.

The History of Biology. *a Survey* By Erik Nordenskiold. Translated from the Swedish by Leonard Bucknall Eyre Pp xii + 629 + xv + 16 plates (London Kegan Paul and Co., Ltd., 1929) 25*s* net

A SYSTEMATIC historical account of the development of biology has long been a desideratum, and, as Dr Raymond Pearl says of the German edition, " the blank has been admirably filled by Erik Nordenskiold ". The author is a trained original worker in zoology, whose experiences, among others, ranged over the shores of the North Sea at the St. Andrews Marine Laboratory, and whose zeal, erudition, and scientific accomplishments enabled him to deal with the subject no less adequately than his facile pen portrayed.

The task undertaken by the author was one of no ordinary magnitude, involving infinite labour and careful judgment in addition to an extensive and sound knowledge of biology, so that he was enabled to grasp the trend of the labours and epitomise the main facts or theories of the writers from various points of view, as well as bestow sound criticism The work is divided into four heads · (1) Biology in classical antiquity, (2) biology during the Renaissance, (3) biology in the seventeenth and eighteenth centuries; (4) biology during the first half of the nineteenth century The author centres in Babylon, that ancient home of civilisation, the early acquaintance with the subject from contact with animals—though Oriental wisdom was largely composed of the mystical and the magical—matured and developed by a powerful priesthood The Egyptian and Israelitic, the Hindu and Chinese conceptions followed. Amongst the earliest scientists of Greece, again, were the Ionian philosophers, some of whom, like Thales, regarded water as the cause of all things—even the earth coming into being from its condensation, whilst living forces were evolved by a kind of primordial procreation in the mud. The influence of the philosopher Pythagoras on scientific development was great, as also was that of Plato, who laid the foundation of biological systematisation. The early medical writings of Greeks, such as those of Hippocrates (the Great) " on air, water, and places "; and the belief that the body was composed of four elements—fire, air, water, and earth—closed the period of natural philosophers' speculations. Yet about this time human osteology was studied so far as the skeleton, the brain, nervous system, the eye, ear, and the urogenital system

The advent of Aristotle, one of Plato's students, and the greatest biologist of antiquity, meets with ample treatment. He upheld the domination of form, that is, of the spirit, over matter, and of motion as the origin of all things As a prolific writer on biology, metaphysics, statesmanship, and art, his influence was great He interested himself in marine as well as land animals, indeed, the former are better represented in his works than the latter His evolution was a product of divine wisdom, whereas that of Democritus was the dominion of necessity

The anatomists of Alexandria and those of Arabia next come under review, and thereafter Pliny and Galen are dealt with, as well as the condition of science in the Middle Ages Moreover, the institution of universities in the twelfth century as growths from the cathedral schools was a noteworthy development As the pupils at these schools increased in number the teachers combined to form what was termed a *Universitas magistrorum*, and thus the Universities of Paris, Oxford, and Leipzig were founded.

During the latter part of the Middle Ages biology was often prominent, though the writings of Aristotle were chiefly followed, and a compilation of the literary material of the past was common. One man, however, resolutely fought the schoolmen and their antiquated views, this was Roger Bacon, and he led the way to the future Renaissance. Nature was now to be studied unfettered by Church dogmas and scholastic systems, and thus biology reached results far beyond those of Aristotle or Galen Ushered in by the " Novum Organum " of Francis Bacon, a number of distinguished authors in zoography, anatomy, medical science (including dissection), such as Vesalius and Fabricius, led up to the epoch-making discovery by Harvey of the circulation of the blood, which ousted from the field all the previous erroneous views.

The end of the seventeenth and the eighteenth century was marked by the appearance of mechanical Nature-systems such as those of Descartes, Hobbes, and Spinoza; yet Boyle, the first modern chemist, and Newton, the illustrious discoverer in mathematics and optics, flourished. The end of the seventeenth century saw the discovery of the lymphatic system and notable advances in anatomy and physiology, the author consistently giving to each discoverer a due meed of praise—the result of his own industry in master-

ing their researches. Names familiar to every student of biology, such as Leeuwenhoek and Malpighi, are crowded in this great period in the history of anatomy. The beginning of the eighteenth century saw a further series of able workers, commencing with Sydenham and Hoffman (the latter holding that matter and motion formed the foundations of existence), to Swedenborg's investigations of the brain.

Before the advent of Linnæus, attempts to classify plants had been made by Cesalpinus, Tournefort, and Ray, the "Historia plantarum generalis" of the latter forming an important treatise He also wrote two zoological works of note; and, besides his later publications, which were extensive, he made advances in realising the difference between species and genus, and he had a keen eye for natural groups

In the treatment of Linnæus the author's skill in epitomising the salient features of a distinguished man's career are conspicuous He shows that Linnæus possessed an extraordinary capacity for observing natural objects and surroundings, and such he used in the various important works, for example, the "Systema Naturæ". His plant-system and his binomial nomenclature are amongst his most successful performances The account of Buffon and his friend Daubenton follows, the theoretical ideas of the former and the anatomy of the latter bearing important fruits

The advance of natural science in the eighteenth century by Réamur, the experimental and speculative biology of Haller, Bonnet's parthenogenesis, Wolff's generation-theory and epigenesis and other noteworthy features of the period are fully dealt with Descriptive and comparative anatomy by Albinus and Camper, as well as the labours and the museum of John Hunter, carry us to Pallas, zoologist, botanist, and traveller—all receiving careful treatment. Modern chemistry and its influence on biology is then considered, whilst critical philosophy and romantic conceptions of Nature follow. Kant, Fichte, Goethe and his metamorphosis of plants are all ably criticised, as also Oken's natural philosophy, Erasmus Darwin and his "Zoonomia", E. G. St Hilaire and his fundamental type of vertebrates

We now reach biology in the first half of the nineteenth century—a period in which a galaxy of eminent comparative anatomists occur—from Vicq d'Azyr to De Blainville, two names being especially familiar, namely, Lamarck and Cuvier, though all are noteworthy. Lamarck, from his numerous works, is looked on as a pioneer of modern biology. His life-theory is motion, and he asserted that spontaneous generation goes on incessantly under heat, light, and electricity. Cuvier's chief investigations were in the vertebrates —both living and extinct To the last he held to the immutability of species and to the incomparability of types, Bichat and De Blainville both accomplished important work. Embryology received great advances, especially experimentally; workers in microscopy and cytology were numerous, others in the field of geology also made great strides. Then came Darwin, whose sketch gives another example of the author's method and fairness to the great naturalist, his supporters and opponents His theory early found a home in Germany, championed by Gegenbauer and Haeckel, and his influence compelled a whole generation everywhere to follow his line of thought.

The discovery of microbes by Koch, the work of Anton Dohrn at Naples, the researches on heredity and descent, the advance of experimental biology, and distinguished workers who followed Mendel, or extended biochemistry, conclude this remarkable book with its thirty-two portraits of ancient and modern biologists. The author, indeed, has accomplished a task almost as formidable as that of his distinguished uncle in surmounting the North-East Passage.

W. C. M.

Medieval Devil Worship.

The History of the Devil: the Horned God of the West By R Lowe Thompson Pp xiv + 172 + 8 plates (London Kegan Paul and Co, Ltd., 1929) 7*s* 6*d*. net.

It is interesting as well as instructive to reflect that, even at the beginning of the present century, it was not an uncommon thing to find the religious practices of primitive peoples described in the pages of missionary magazines as 'devil worship', and the term is still frequently ascribed in popular language to the Voodoo rites of Haiti The missionary of to-day will not be responsible for a like crudity; but his predecessors in stigmatising what was outside the pale as the province of the Adversary, was following the precedent of the early Church. For the early Christians the devil was a very real problem. Not only had eastern religion and philosophy made familiar the opposition of the good and evil principles, the Church was constantly confronted with the problem of backsliding, more often than not involved in the performance of civic duties. Further, the Christians were the more harsh in their condemnation because they themselves in

their attitude to the world of spirits were not far removed from the pagans, even though they worshipped other gods

Therefore heretics, whatever their heresy, were ensnared by the devil, Manichees, gnostics, and the like were not merely theologically in error; they were actively worshippers of the evil one, their assemblies orgies of debauchery—scenes such as Walter Mapes describes writing of the Patarini, when indeed he seems to be attributing to these heretics nothing more than an inversion of the Christian agape or love feast. Most of the accusations of blasphemy brought against the witches show the same lack of imagination and were formulated by a simple inversion in every detail of the practice of the Church Whether or not these accusations had any foundation in fact, the practices thus recorded are not pagan ritual unless the sexual licence is regarded as a fertility rite. The sacrificial meal in the circumstances points no more in one direction than the other In fact, if the Bull of Innocent VIII. be taken as defining the medieval witch, it appears that outside certain popular conception of magical powers—blasting crops, casting spells on cattle and persons, and the like, ideas common to all primitive peoples—the distinguishing mark of the witch is the compact with the devil This is purely a theological conception which can be traced back to the early days of the Church So far there is support for those who hold that witchcraft was a form of heresy which threatened the existence of the Church and therefore exonerates it from the odium of a persecution which grew out of a baseless superstition

To the average modern the medieval mind is a closed book. Of all its manifestations the witchcraft persecutions are the most difficult to understand. Any investigation or theory which can help to bridge the gap between modern times and the Middle Ages deserves to be weighed before it is rejected. It is for this reason that Miss Murray's book on the witch cult in Western Europe and now Mr. Thomson's book on the devil are welcome They offer theories which, to an anthropologist at least, come within measurable distance of an intelligible formula, of a cause for action which, if not such as moves the modern educated mind, is at least intelligible at a certain stage of culture Mr. Thomson, with Miss Murray, believes that witchcraft was a system of religious worship with a regular ritual, meaningless in its medieval context, which had survived from a primitive fertility cult Of this the central figure, the devil, was in earlier times the Celtic horned god Cernunnos, a figure in turn derived from the masked figures of palæolithic art, and in particular the well-known *sorcier* of the Trois Frères cavern at Les Eyziès The horned tailed figure of the last named must inevitably recall the horned medieval devil

Mr Thomson supports this view by a wealth of argument; but there are difficulties For one thing, there is a lengthy gap between palæolithic times and the Cernunnos of the Iron Age It is difficult to believe in a popular cult entirely submerged for that length of time Further, is Cernunnos himself indubitably indigenous to Western Europe? The cult of the goat in connexion with witchcraft did not reach Britain. Is that because it had a Mediterranean origin and distribution only? There is, however, this much to be said for the view, that there was something of the nature of a popular cult at the back of witchcraft It is difficult to explain away the evidence in the English trials, and some of the Scottish and Continental evidence, on any other view The actual words of the confessions seem to convey the convictions of the speakers and seem to be too consistent *inter se* to be hallucinations. If it were not for this the whole witchcraft persecution and the devil cult might be more properly regarded as an inglorious, if logical, climax of the whole body of previous Christian theology and ecclesiastical history.

Mr. Thomson follows the lead of the devil along many entertaining by-paths. Among his modern instances his account of the recent case of the Abbé Desnoyers, near Melun, would have gained in interest had he told the whole story This remarkable case was really a battle between two cults. In this, as in the previous case six years before, the original offence which gave rise to the accusation of witchcraft was not in the details given in the courts which Mr Thomson quotes, but in the fact that an image of the Madonna which shed real tears and belonged to Mme. Mesmin, on whose behalf the Abbé was attacked, had been made by him to cease to function.

Neurology and Psychology.

The Matrix of the Mind By Prof Frederic Wood Jones and Prof Stanley D Porteous Pp. xi+457. (Honolulu, T H.: University Press Association, London· Edward Arnold and Co., 1928) 21*s*. net

THE two authors of this unusual book, one an anatomist, one a psychologist, set out to blend the "subject matter and viewpoints of two sciences . . . neurology and psychology". As they point

out in the preface, the ordinary text-book of psychology makes little or no attempt to relate the structure of the brain to its function Neurology, however, comprises more than the facts of the structure of nervous system, and the author of the first portion of the book (that dealing with structure) has produced a most readable general review of comparative neurology in both its structural and functional aspects The evolution of the neopallium, the portion of the brain believed by the morphologist to be the cortical structure concerned with the complex correlation of the different sensations, and therefore probably the organ of mind, is traced through the vicissitudes in the phylogenetic development of the sense organs. The reflection of animal behaviour upon the sense organs, and consequently upon their nervous connexions, is illustrated by many particularly entertaining and original accounts of the behaviour of some of the Australian fauna in relation to the structure of their brains.

This means of approach to the study of mind reveals, however, that the morphologist has to restrict himself to wide generalisations in the relation of behaviour to structure It is evident that, just as the morphologist is unable to deduce from the structure of the nervous system of a certain frog that it will react to the sound of a splash by diving into water, so the psychologist cannot, at present, base any but the most gross errors in mental make-up on any structural alteration Nevertheless, since the evolution of behaviour does carry with it recognisable structural changes, there is presumably some structural basis, as yet unknown, underlying minor changes in behaviour in any one particular species, and it would therefore seem profitable to make the utmost use of such structural alteration as can be found in cases of human psychological abnormality.

The second portion of the book (dealing with the psychological aspect) is disappointing from this point of view, for little attempt is made to enlarge upon the behaviouristic significance of the morphology of the sense organs and the neopallium in connexion with psychology and psycho-pathology. Instead, the working of the mind, with the usual discussion of sensation, attention, and behaviour, in terms of the outworn physiological principles of 'facilitation' and 'synaptic resistance', is here further involved in new functional theorems such as the "theory of neural counter-currents" deduced from physiological statements which are inaccurate, and a theory of the origin of motor and sensory decussations which is difficult to harmonise with the appearance of such decussations very low in the animal scale, but also entirely disregards the nature of the sensory pathways except for the number of times they cross the central axis An admirable feature of the whole book, however, is the emphasis which it lays on the necessity for adequacy of stimulus in appraising reaction

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Our Bookshelf.

Bird Watching on Scolt Head By E L Turner Pp. viii + 84 + 47 plates (London. *Country Life*, Ltd, 1928) 10*s*. 6*d* net

In the present volume Miss Turner gives us the results of her two years' watching on Scolt Head, one of the sanctuaries run by the Norfolk and Norwich Naturalists' Society. Miss Turner is one of those very few people who possess not only keen powers of observation, a wonderful knowledge of bird life, with an immense store of energy and perseverance in carrying out any work upon which she embarks, but, fortunately for us, also has the ability to set forth the results of her work in a most charming manner.

Naturally, everyone will not agree with all the opinions which Miss Turner expresses, but, even where we disagree with them, we shall be none the less interested in what she tells us, or the less pleased with the manner in which she does it Scolt Head is now undoubtedly one of the most interesting sanctuaries in the whole of Great Britain, both on account of the many birds which breed there and because it forms a wonderful resting-ground for migratory birds on both their spring and autumn travels. Miss Turner's work lay principally with the breeding birds, but during her long months' vigils she lost no opportunities of dealing also with the visitors to her island, and the oldest observers may learn something from her work on Scolt Head Even the keenest of Nature lovers make slips sometimes, and we should like to have seen the dwarf fire-crest which Miss Turner says measured only 2½ in *across* the wings; perhaps she meant 4½ in

The book is profusely illustrated with very beautiful photographs, both of the birds themselves and of the scenery in which they live the paper on which the text is printed is good and light, and the book is a pleasure to read without being a labour to hold.

(1) *Atomic Structure as modified by Oxidation and Reduction* By Dr. W. C. Reynolds. Pp viii + 128. (London Longmans, Green and Co., Ltd., 1928) 7*s* 6*d* net

(2) *La structure du noyau de l'atome, considérée dans la classification périodique des éléments chimiques.* Par Charles Janet. Pp 67 + 3 planches (Beauvais. Imprimerie Departementale de l'Oise, 1927) n p

(1) There are no problems of greater interest at the present time than those of atomic structure as elucidated by the study of emission and absorption

spectra. This study has the merit of providing a rigid experimental basis for chemical doctrines of valency and of molecular structure; but the author ignores all this valuable material and prefers to rely on imagination rather than on knowledge of the behaviour of electrons. In these circumstances a responsible teacher might well be excused if he advised his students to seek wisdom elsewhere, and to spend their money in purchasing a real romance from the learned pen of Mr J J Connington (who, we believe, is in private life a professor of chemistry), rather than spend both time and money in an effort to distinguish between fact and fancy in Dr. Reynolds's tables of atomic structure

(2) A similar criticism can be made of Janet's study of the structure of the nucleus At a time when the relevant energy-levels are being determined experimentally from the properties of β-rays, the value of a purely imaginative study of the distribution of electrons and protons in the nucleus is surely negative rather than positive, since it represents a dissipation of energy which might have been converted into useful work.

Contributions to Analytical Psychology By C. G Jung. Translated by H. G. and Cary F Baynes. (International Library of Psychology, Philosophy, and Scientific Method) Pp. xi + 410 (London Kegan Paul and Co., Ltd.; New York. Harcourt, Brace and Co, Inc., 1928) 18*s* net.

IT is several years since Jung's "Psychological Types" was published in this series, and the present volume is the first of the author's works to appear in English since then It is well known that there is, under the name psycho-analysis, no common body of doctrine which is held by its most distinguished representatives Attempts have been made to show that the theories of Freud and Jung, for example, are not so antagonistic as they seem. One such attempt constitutes a volume in this same series. But Jung himself can scarcely keep within the bounds of polite language in denouncing the Freudian sex-hypothesis as a fanatical creed The volume before us is full of interest from cover to cover, and it well exemplifies what the reviewer regards as Jung's reasonableness and sanity. He applies his theories to problems of modern life, including women in Europe, marriage as a psychological relationship, analytical psychology and the poetic art, and analytical psychology and education. It is to be noted that, apparently on the principle that one cannot touch pitch without soiling one's fingers, Jung eschews the term 'psycho-analysis'. He prefers the term 'analytical psychology'.

Der Bau der Erde: eine Einfuhrung in die Geotektonik Von L Kober. Zweite neubearbeitete and vermehrte Auflage Pp iv + 499 + 2 Tafeln. (Berlin. Gebruder Borntraeger, 1928) 27·60 gold marks

THE first edition of this work appeared in 1921, and was a series of discussions of tectonic problems rather than a text-book. This present edition practically amounts to a new work, for much of the arrangement, terminology, and substance is new. The book now consists of five hundred pages compared with the three hundred of the first edition Prof Kober justly claims the present work as the first text-book of geotectonics The book certainly stands alone; it is approached by some recent German publications, but there is nothing in English of the same calibre

The author, starting with the division of the earth's crust into kratogenetic (stable) and orogenetic (mobile) zones, proceeds to discuss these divisions with respect to facies, movements, and mountain-building The results are applied to the continents and oceans in turn Finally, many theories, such as those concerning the origin of continents and oceans, are summarised The book is up-to-date, it includes, for example, an account of Stille's work in Saxony, of G. M Lees' work in the Persian Gulf, and of the results obtained by the *Emden* during echo-sounding cruises in 1927.

The typography is good, illustrations adequate, and misprints few The bibliography is not up to the standard of the book, and an index would have been useful for a volume of this size.

Recent Advances in Hæmatology. By Dr A. Piney. (Recent Advances Series) Pp x + 318 + 4 plates (London· J and A Churchill, 1928) 12*s*. 6*d*. net.

THE demand for a second edition of this book within twelve months of the appearance of the first is an indication of its well-deserved popularity Dr. Piney has made additions to every chapter, in order to include the most recent views on all aspects of his subject, and a new chapter is given describing the spleen in various infections.

The author considers hæmatology on an essentially morphological basis. Modern views on blood chemistry are therefore not included, and, as is pointed out in the preface, the term hæmatology is not generally intended to cover the subject of serology. Treatment is discussed in relation to each disease or group of diseases, little progress has been made recently in this direction, but the administration of liver in the treatment of pernicious anæmia is mentioned The glossary is very useful to those not familiar with pathological terms, and there are numerous references to original articles and text-books

A Manual of Elementary Zoology. By Dr. L. A. Borradaile (Oxford Medical Publications) Sixth edition Pp xvi + 683 + 25 plates. (London Oxford University Press, 1928.) 16*s*. net.

THE principal alterations in the sixth edition of this excellent and well-produced text-book are the revision and extension of the chapters on sex, embryology and evolution A "concise account"—about a page—of the snail (*Helix*) has been added, but this is too short to be really serviceable. It contains no description either of the reproductive apparatus or the ganglia—the former is simply noted as "complicated, hermaphrodite" and the latter as "concentrated into a clump around the gullet" The figure of the senile form of *Entamœba* with buds might have been omitted.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Mass-Spectrum of Lead from Broggerite.

IN the issue of NATURE for Mar. 2, 1929, Dr. Aston gives the results of his determination of the mass-spectrum of a sample of lead in the form of its tetramethyl compound, of which the lead had been extracted by us from a sample of Norwegian broggerite. We obtained the lead in the form of chloride, and took particular care to have it free from impurities. The conversion of the chloride into tetramethyl was kindly carried out for us by Mr. S C. Witherspoon, and care was taken to test all chemicals and reagents used to see that they were free from lead

Dr. Aston discusses his results and reaches interesting conclusions, and a further discussion is given by Sir Ernest Rutherford. It may be of interest to consider the matter further, in the light of our analysis of the mineral.

The specimen was obtained from a trustworthy dealer and bore the label "Uraninite, var. Broggerite, Karlshus, Raade, Smaalenene, east of Kristianiafiord, Norway". It appeared to be homogeneous except for a little pink feldspar, mica, and quartz, and was of an iron-grey colour and of the general appearance of massive magnetite, but with some crystal faces. Close examination showed no evidence of its having been acted upon by weathering processes Our analysis is as follows .

$$\left.\begin{array}{l} U_3O_8 = 72{\cdot}12 \text{ per cent} \\ ThO_2 = \ \ 4{\cdot}98 \\ PbO = \ \ 8{\cdot}64 \end{array}\right. \left\{\begin{array}{c}\text{equi-}\\ \text{valent}\\ \text{to}\end{array}\right\} \begin{array}{l} U = 61{\cdot}158 \text{ per cent.} \\ Th \quad 4{\cdot}377 \\ Pb = \ \ 8{\cdot}018 \end{array}$$

We have confidence in the essential accuracy of these figures.

For calculating the age we used the formula given by the International Critical Tables of the National Research Council :

$$\text{Age} = \frac{\log (U + 0{\cdot}38 \text{ Th} + 1{\cdot}156 \text{ Pb}) - \log (U + 0{\cdot}38 \text{ Th})}{6{\cdot}5} \times 10^{11} \text{ years.} \qquad \text{(I)}$$

This gives an age of $919{\cdot}5 \times 10^6$ years for this mineral. Changes which might be made because of some variation in the values of the disintegration constants involved in the factor 6·5 of the formula are not likely to be of large amount. The calculated age is in good agreement with previous determinations by others on uranium minerals from the same general locality. We may now compare this value with results obtained by making use of Dr. Aston's figures in connexion with our analytical results.

Dr. Aston gives the figures 86·8, 9·3, and 3·9 as the percentage values obtained for Pb^{206}, Pb^{207}, and Pb^{208} present in the lead tetramethyl. Of these isotopes of lead, the first and second have presumably been derived from uranium and its isotope actino-uranium, and the third from thorium. In analysis, uranium^{238} and actino-uranium are necessarily determined together as 'uranium', and their disintegration has resulted in Pb^{206} and Pb^{207} respectively. Calculations of age from these elements, disregarding thorium and Pb^{208}, should give practically the same result as the original calculation, and these results in turn should agree with the result that thorium and Pb^{208} give. For uranium plus actino-uranium we express the formula as

$$\text{Age} = \frac{\log (U + 1\ 156 \text{ Pb}^{206+207}) - \log U}{6{\cdot}5} \times 10^{11} \text{ years (II)}$$

and get

$$\text{Age} = 908{\cdot}4 \times 10^6 \text{ years.}$$

This may be considered a satisfactory agreement with the $919{\cdot}5 \times 10^6$ years previously obtained.

For thorium and its lead we have

$$\text{Age} = \frac{\log (0{\cdot}38 \text{ Th} + 1{\cdot}156 \text{ Pb}^{208}) - \log (0{\cdot}38 \text{ Th})}{6{\cdot}5} \times 10^{11} \text{ years.} \qquad \text{(III)}$$

From this calculation, however, we get the result

$$\text{Age} = 1313 \times 10^6 \text{ years,}$$

which is widely different from the previous figures.

It is pertinent to inquire as to the probable cause of the discrepancy

In Dr. Aston's account he expresses some uncertainty as to relative intensities of the lead lines, and gives a margin of possible error of ± 2 for Pb^{208}. In view of the small total quantity of Pb^{208}, this means a large percentage error, the possible variation running from 5·9 to 1·9 per cent, and corresponding ages (calculated by formula III) running from 1900×10^6 to 671×10^6 years. The limits of error, therefore, include the value $919{\cdot}5 \times 10^6$ deduced from the original calculations, but if this is accepted as correct, Dr Aston's figure for Pb^{208} apparently requires correction to bring it into harmony. The limits of error he himself sets likewise point to the desirability of greater refinement of photometric measurement in order to make the results serve for age calculations. Instead of 3·9 per cent of Pb^{208} given by him, our figures indicate 2·64 per cent, which is obtained by substituting in formula III the age $919{\cdot}5 \times 10^6$ years and the analytical value of thorium, and solving for Pb^{208}

There is, however, another aspect of this matter which should be considered. Formula III involves the factor 0·38, accepted as expressing the disintegration equivalence of thorium in terms of uranium. It may be thought that it is this factor which should be revised, as there has been some variation in determinations of the value of this quantity among different experimenters. As a basis for judgment in this matter we may make a new calculation of the conversion factor from the data supplied by Dr. Aston. For this purpose we combine formulæ II and III in the form

$$\frac{U + 1{\cdot}156 \text{ Pb}^{206+207}}{U} \quad \frac{x\text{Th} + 1{\cdot}156 \text{ Pb}^{208}}{x\text{Th}} \qquad \text{(IV)}$$

and solve for x.

Such a calculation does not involve the correctness of the constants in the uranium series, but only the value of the conversion factor required to get identical results for the uranium series and the thorium series.

Proceeding in this manner, we get the result 0·57. Possibly it may be regarded as an open question whether the accepted value 0·38 obtained by direct measurement by physicists does not require correction to bring it into closer accord with the figure 0·57 derived from Dr. Aston's work, but in reading Dr. Aston's letter we are left with the impression that Dr. Aston himself does not wish to be held too strictly to the numerical values that he gives.

Furthermore, previous work by one of us (*Amer. Jour. Sci.*, November 1928) has given support to the substantial correctness of the figure 0 38. Two

not the specimens from which lead was separated for atomic weight determination.

Clearly there is a vast field of geological research now open to investigation by the long neglected helium method If our initial hopes are realised—and these preliminary results provide ample encouragement—a method is now available for dating all fresh igneous rocks which have not been heated up or metamorphosed since they came into place There should not be the slightest difficulty, for example, in distinguishing Carboniferous dykes and sills from those of Tertiary age. It should be equally easy to settle with certainty the controversy as to whether the Carrock Fell complex belongs to the Ordovician or to some later epoch of igneous activity. There are many such problems awaiting solution in every country where igneous rocks occur. Moreover, since igneous rocks suitable for the helium method are far more abundant and far better distributed in time than are radioactive minerals suitable for the lead method, there is now available a practical means of effecting long-distance correlations and of building up a geological time-scale which, checked by a few reliable lead-ratios here and there, should become far more detailed than could ever be realised by means of the lead method alone.

Further work is in progress on the north of England rocks, and it is our intention as soon as possible to begin the systematic prosecution of this extremely promising line of research. Dr. R W. Lawson has consented to collaborate in the work by making the helium determinations and by carrying out a quantitative investigation on the possibilities of escape of helium in various circumstances.

V S DUBEY
Department of Geology and Mining,
Gwalior State, India.
ARTHUR HOLMES.
The University, Durham, May 6.

A Case of 'Siamese Twins' in the Spiny Dogfish (*Squalus fernandinus*).

THE occurrence of a case of Siamese twins in fishes has, so far as we are aware, not previously been recorded. The present example was recently discovered by one of us (J. M) amongst the material collected during the survey of the Cape seas by the s.s. *Pieter Faura* about twenty-five years ago. Unfortunately, no records of the finding of this abnormality appear to have been kept, and one can therefore only speculate as to how it was originally found.

It is well known that this particular species of dogfish is viviparous, the female giving birth to as many as half a dozen young at a time. In the dissection of the uterus of a gravid female, the young are found to be fully developed except for the possession of a yolk-sac, which in these cases takes on the function of a yolk-sac placenta, being in intimate contact with the wall of the uterus, which appears to be specially folded to receive the surface of the yolk-sac. At birth, the young is born fully developed, the yolk having been completely absorbed, the yolk-sac having shrivelled up.

In the 'Siamese twins', as is well shown in the accompanying photograph (Fig. 1), the umbilical cords are still present, each embryo being provided with one. One is struck by the position of these cords, which here have their exit in the neighbourhood of the pectoral girdle as opposed to the normal abdominal position. The integument and the muscles surrounding the bases of these cords were incomplete, so that a large opening was left for the exit of the cords, the cœlom thus being in direct communication with the exterior.

The fact that the umbilical cords were still visible externally—the yolk-sacs had apparently been broken off, for they are entirely absent from the specimen—leads one to the conclusion, based on the advanced state of development of the newborn young, that the twin was found during the dissection of the uterus of a gravid female.

FIG 1 —'Siamese twins' (spiny dogfish)

A brief description of the external appearance of the abnormality may prove of interest The anterior ends, as far back as the pectoral fins, are free, being attached to a single trunk and tail Thus we find that there are a pair of pectoral fins to each free thoracic part, while the first and second dorsal fins are symmetrically developed in their normal positions. Spines are developed in front of each dorsal fin. The tail presents a peculiar appearance. The caudal fin is double, symmetrically developed about the median horizontal axis The part corresponding to the ventral lobe of the caudal fin of a normal individual is twisted through a plane of 90° so as to lie in the horizontal instead of the vertical plane This lobe of the caudal fin is also shown in Fig 1. Along this side of the caudal region a deep groove is continuous from this fin up to a line through the posterior ends of the second dorsal. The other caudal lobe is entirely absent. The ventral fins are a single pair which has become displaced so as to lie laterally on one side of the trunk. Each on its inner surface has a well-developed clasper, while the single anus is also displaced and lies between the bases of the ventrals.

The two heads are apposed by their ventral surfaces, each being perfectly normal, the mouths and nostrils facing each other. The normal five pairs of gills are also present on each head.

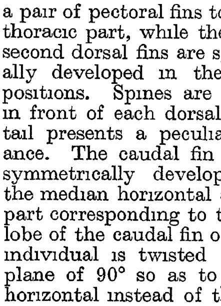

FIG 2 —Transverse section along line A B of Fig 1 to show duplication of the vertebral column, etc C, centrum, gr., groove, h a, hæmal arch, l a, lateral arch, m, myomeres, n a, neural arch, n sp, neural spine, s c, spinal cord

It has not yet been possible to make a detailed dissection of the specimen, but a transverse section across the tail, just behind the second dorsal fin, shows that the vertebral column is double, each column appearing symmetrical about the median horizontal plane A vertebra of each column consists of a centrum, the neural arches forming the neural canal in which the nerve cord lies and ending in the neural spine On the side of the groove above referred to, there appears a single lateral arch with spine lying against the base of the groove, enclosing a lateral blood-vessel. The two centra are separated by a space bounded above and below by the centra, on one side by the laterally placed arch, and on the other by a sheet of cartilage. This space is divided by a horizontal membrane to form two hæmal arches in which the caudal veins and arteries run.

We hope to make a detailed dissection of the various

internal structures in the near future in order to examine the various parts and to ascertain which are duplicated and which single.

C. VON BONDE.
J. MARCHAND

Fisheries and Marine Biological Survey,
Cape Town,
Union of South Africa.

The Past Cold Winter and the Possibility of Long-range Weather Forecasting.

MODERN meteorology has made notable advances in forecasting the weather of the next day, but when it attempts to predict the weather for more than a week ahead, the percentage of successes does not exceed fifty at the most One reason for this failure is to be found in the refusal of the modern meteorologist adequately to take into account in the problem of weather prediction of direct terrestrial influences, such as that of the physical state of the surface waters of the oceans, even though he may be ready enough to take such an influence into account when dealing with one of those aerodynamical problems—for example, the life history of an Atlantic 'depression'—which he regards as lying within his particular province Another reason is his neglect of the 'Polar Front' theory of Prof. Bjerknes, one of the greatest authorities on aerodynamics and hydrodynamics.

Prof. Bjerknes regards the polar regions as caps of cold air maintained largely in consequence of the local accumulations of ice and snow, offering a kind of cold circular wall facing the warmer winds of temperate latitudes. He considers that in conjunction with the strongly heated equatorial regions, they set up a circulation which brings warm air aloft from the equator to the pole, there to be cooled and to sink, weighed down by its increasing density, until it is absorbed into the polar cap; that these reservoirs of cold air at the poles are constantly discharging their accumulated air towards the equator along the earth, in accordance with 'impulses' supplied by the region of low barometer around the equator; that the trade-winds represent successful attempts on the part of such accumulations of polar air to reach the region of equatorial calms. He supposes, further, that the cyclones of the North Atlantic arise through the mixing of the cold and warm air-masses along the margin of the polar cap (the so-called 'polar front').

It is clear that a great simplifying theory such as this offers a basis for long-range forecasting of the weather in our latitudes If we accept the theory, it is not difficult to see that the general character of the weather over long periods may follow changes in the extent and shape of the region of cold sea, for the polar caps must, in the long run, coincide with the regions of coldest water. For example, the presence of a tongue of warm water projecting into Arctic regions, such as the so-called Gulf Stream of the North Atlantic, will push this boundary back towards the pole, and cause contrasts such as are offered in winter by the cold climate of Labrador and the relatively mild climate of Iceland.

We may consider now whether the past severe winter cannot be connected with some modification of the normal temperature of the seas within the area of exceptional cold The immediate cause of the severe weather has clearly been the persistence of northerly and easterly winds over Russia and Central Europe circulating round an 'anticyclone' or region of high barometer over Scandinavia and Finland; which anticyclone has generally been separated from the area of high pressure that normally covers Siberia in winter by a region of relatively low pressure over Russia. Now Prof. Witting found in the Baltic in the summer of 1927 a layer of cold water at a depth of about 10 fathoms, beneath the very warm surface water, heated by the sun, having altogether a volume much greater than that of a whole normal year's outflow from the Baltic into the North Sea, and having a temperature about 10° F. lower than the average. The surface waters of the Baltic are derived ultimately from the mixing of the river water with that finally ascending from such deeper layers, and this cold water might well chill their surface waters, and the air in contact with them, for two years or more, in accordance with the time that the water might be expected to take in passing away along the Norwegian coast [1] Such chilling would cause the anticyclones which are so apt to form over Scandinavia to be more than usually persistent, as has been the case this winter. In this way the action of the cold water, which is far too small to produce directly a degree of cold such as has been observed, may do so indirectly through the agency of the wind, and the resulting accumulations of ice and snow will carry the process still further

It seems clear that if the action of a single sea such as the Baltic can be so great, there is a great field open for international co-operation in the systematic study of the physical states not only of the Baltic but also of all the seas and oceans in and around Europe, including the Caspian and the Black Sea. This should be done once a year, if not twice, and the results should be published quickly, so as to be available for long-period weather forecasting. This was in fact the policy of the International Council for the Exploration of the Sea before the War. It is hoped that the remarks that I have made will show that permanently to abandon such a scheme may be to throw away the opportunities of saving millions of pounds that would be afforded by the prediction, in good time, of winters such as that of 1928–29.

W. J PETTERSSON

[1] The brackish water leaving the Baltic by the Oeresound and the Belts afterwards forms the 'Baltic current' along the west coast of Sweden and Norway

Refraction of Light Waves by Electrons.

IT is an established fact that wireless signals transmitted from any place are readily received at the diametrically opposite place on the globe. The explanation usually given of the phenomenon is that the ions in the Heaviside layer make the speed of propagation of the waves greater in that layer than in the ordinary air below and thus bend the waves round the earth by a process of refraction. Larmor has developed the mathematical theory of the refraction (*Phil Mag.*, December 1924), and has shown that if c is the velocity of light in vacuum and c' in the presence of electrons, then c and c' are related by the equation

$$-N\,.\,\frac{e^2\lambda^2}{\pi m}\Big),$$

where N is the number of electrons per unit volume, e and m are the charge (in e m.u.) and the mass of an electron, and λ the wave-length Assuming $\lambda = 10^5$ cm for radio waves, calculations show that an electron density of 0 3 per c.c is enough to produce the observed bending round the earth.

In the case of light waves, λ is of the order of 10^{-5} cm This will lead to a large value of N in order that light waves may bend round the earth. If the refraction of light waves by electrons is to be observed in the laboratory, the curvature of the rays has to be much larger, and hence a still larger value of N will be required.

So far as we are aware, the bending of light waves by electrons has neither been attempted nor its possibility discussed For some time past we have been

experimenting to detect this effect, but before trying the actual experiment we thought it worth while to discuss if, under ordinary laboratory conditions, it is possible to obtain a sufficiently dense cloud of electrons to produce observable bending of a light beam. The results of our theoretical deductions are here set forth

Langmuir has shown (*Phys. Rev*, April 1923) that the density of space charge (ρ_0) at the surface of a plane hot surface is given by the equation

$$\rho_0 = 19260 \times i_0/\sqrt{T} \text{ e s u. per cm}^3,$$

where i_0 is the saturation current expressed in amperes per sq cm of the hot surface at temperature T° K

The density of space charge (ρ) at a distance y from the surface is also given by

$$\rho = \rho_0/(\sqrt{2} \,.\, L_0 \,.\, y + 1)^2,$$

where $L_0 = 4\ 59 \times 10^5 \times T^{-\frac{3}{4}}\sqrt{i_0}$ cm $^{-1}$, expressed in amp. A thoriated tungsten filament of diameter 0 155 mm. and containing 1 per cent ThO_2 gives an electronic current of about 20 5 amp /cm ^{2} at temperature 2300° K (cf Langmuir, *Phys. Rev.*, October 1923) If we take a strip of thoriated tungsten giving this current at this temperature, then ρ_0 will be equal to 8232 e s.u /cm ^{3}, and the density N of electrons at the surface of the hot strip is found to be $1\ 724 \times 10^{13}$ Also, since $L_0 = 6258$ (approximately), the density (N) of electrons at a distance y is $1\ 724 \times 10^{13}/(8850y + 1)^2$ The expression shows that the electron density decreases rapidly with increase of distance from the strip This variation of density will produce a curvature in a beam of light passing over the surface of such a strip Since, to a first order of approximation, the refractive index $\mu = c/c' = 1 - N \,.\, e^2\lambda^2/2\pi m$, the curvature of the beam at a distance y from the strip will be

$$-\frac{d\mu}{dy} = \frac{e^2\lambda^2}{2\pi m} \cdot \frac{dN}{dy} = -\frac{4\ 6 \times 10^{-5}}{(8850y + 1)^3},$$

for sodium light, $\lambda = 5\ 8 \times 10^{-5}$, the negative sign indicating that the beam will bend away from the strip.

At the surface of the strip ($y = 0$) the curvature of the beam will be numerically equal to $4\ 6 \times 10^{-5}$. If we assume that this curvature is maintained throughout the passage of the light over the whole length of the strip, say 10 cm , then the light beam, which on entering the electron atmosphere just grazes the surface of the strip at one extremity, will on emergence at the other extremity be shifted through a distance of $2\ 3 \times 10^{-3}$ cm. from the surface. This shift will evidently be greater than the actual shift, since the expression for the curvature given above shows that it is not constant but that it diminishes rapidly with the increase of y—the distance from the strip. A more detailed calculation shows that the actual shift will be approximately equal to $7{\cdot}8 \times 10^{-4}$ cm. This shift, though small, should be detectable if suitable experiments can be arranged

The smallness of the shift is due to the fact that the emitted electrons are mostly concentrated near the surface of the strip. At a distance of only 0 1 mm. the electron density falls to one ten-thousandth part of its value at the surface A more favourable condition for bending the light beam will possibly be set up if the electron cloud is pulled upward by a positively charged plate held a few millimetres above the surface of the hot strip

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University College of Science,
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April 11

An Experimental Investigation of the Thermal Relations of Energy of Magnetisation.

THIS note is a first report of experiments undertaken for the purpose of determining the mechanism of the degradation of energy which accompanies magnetisation in ferromagnetic substances. The present experimental method consists in observing the change in temperature of a test specimen produced by a change in the magnetising force at consecutive intervals in a single cycle of magnetisation

The test specimen is in the form of 106 bars of soft steel drill rod 1 mm. in diameter. The bars are so mounted as to form 8 coaxial, concentric cylinders, and the lengths of the cylinders are so determined as

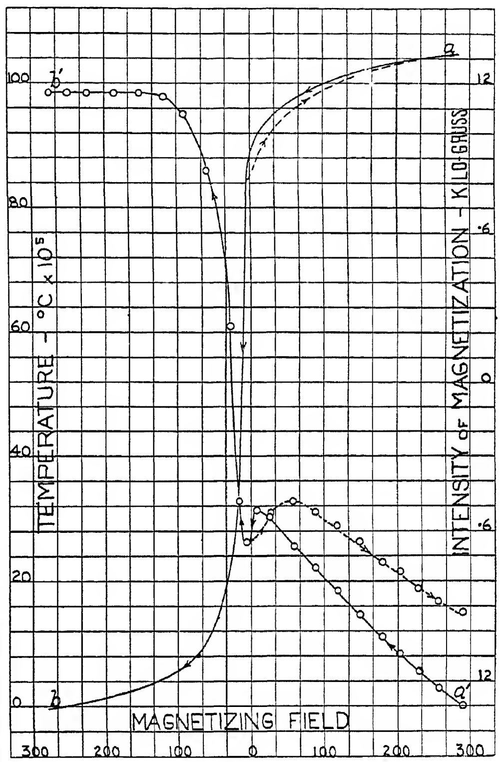


FIG 1

to give the aggregate the form of an ellipsoid of revolution the minor and major axes of which are 3·4 cm. and 60 cm. respectively. 106 copper bars of the same dimensions alternate with the steel bars in the structure. 106 thermocouples are constructed by connecting adjacent copper and steel bars alternately with 3 mm. lengths of No. 40 copper wire and No. 34 constantan wire. A coil around the centre of the ellipsoid permits the evaluation of the total magnetic flux in the specimen. The entire specimen is imbedded in rice powder and placed in an evacuated, silvered glass tube. Adequate thermal insulation isolates the latter from the magnetising solenoid in which it is placed.

The stability of the entire electrical and thermal system is indicated by a zero shift of 2 mm. per hour on a scale 6 metres from the thermocouple galvanometer. A measure of the uniformity of the magnetising field in the ellipsoid is obtained by connecting

half the thermocouples (associated with the inner bars) in opposition to the other half In these circumstances a reversal of the full magnetising field, which produces a rise in temperature of the steel corresponding to a galvanometer deflection of 220 mm., yields a deflection of only 4 mm.

The results of the investigation are given by the accompanying curves (Fig. 1) where intensity of magnetisation and temperature are plotted against true magnetising field Curve *ab* is the upper part of the usual 'hysteresis loop' for the steel. The dotted portion indicates the loop obtained when the impressed field is reduced to zero and then restored to its former value. The curve *a′ b′* shows the total change in the temperature of the steel at every stage in the process of demagnetisation and reversal of magnetisation. The dotted curve shows the total change in temperature corresponding to the process indicated by the dotted portion of the hysteresis curve.

The not inconsiderable cooling of the steel in the neighbourhood of zero magnetising field, as well as the continued cooling accompanying remagnetisation on the upper part of the hysteresis loop, are notable features of this record.

WALTER B. ELLWOOD.

Physics Laboratories,
Columbia University,
New York, U.S.A., April 10.

Mine Lighting and Retinal Sensitivity.

IN the review of Dr Whitaker's recent book on "Mine Lighting" in NATURE of Mar. 2, p. 310, reference was made by the reviewer to the causes of miner's nystagmus. I have not had the opportunity of examining the book myself, and therefore do not know what factors are considered to be most significant in producing this troublesome ocular disease

In my own investigations, however, I have discovered several actions of light upon the retina which are probably of fundamental importance in this connexion. When the retina is stimulated by white or coloured light with an intensity below a certain critical value—α intensity—an inhibitory reaction is evoked which depresses the sensitivity of the visual receptors, whereas if the light is above that value their sensitivity becomes enhanced Thus a feeble light of α intensity is doubly harmful, first, because the intensity is too low for comfortable vision without eye-strain, and, second, because its reflex action is inhibitory in character

In coal mining the source of light is of low intensity, and the reflecting power of the coal surface is also low. It can scarcely be doubted, therefore, that the intensity of light reaching the retina is below the threshold enhancing value, and thus it maintains the receptors in a much depressed condition.

The prevailing view of the visual functions of the spectrum has been to regard all colours or wave frequencies as factors contributing only to the formation of the white sensation. Undoubtedly they have this effect, but it is far from being the whole truth, or perhaps even the most important part of the truth. Each wave frequency is an energy stimulus of a distinctive physiological character the complete functions of which are yet unknown. I have found, however, that the enhancing power of violet light above the α intensity is about seven hundred times as great as that of yellow. Thus it follows that since violet contributes very little to the illuminating power of a light, its chief use when above α intensity is to act as a sensitiser of the retina for the reception of the illuminating colours, a function which it performs with extraordinary efficiency.

I have seen it stated that during the War the Admiralty found the ability to distinguish objects on the sea at night or in feeble illumination was much increased by previously stimulating the observer's eyes with violet or blue light This is to be expected from the extraordinary enhancing power of violet light Probably the same procedure would be beneficial wherever observations are to be made with weak light, such as in the use of the microscope or in counting scintillations, etc.

In mine lighting under present conditions, the lamp seems to have too low an illuminating power and is probably greatly deficient in the sensitising violet rays On both accounts the retinal sensitivity is greatly depressed Under such conditions visual acuity and luminosity contrast on which it depends are both diminished in value.

Possibly the miner's optical troubles could be diminished or even eliminated by obtaining an illuminant which will supply violet rays of the required intensity, and by raising the illuminating power of the light above the threshold enhancing value, which for white light appears to be about 0 25 metre-candle.

Possibly much improvement could be obtained even under present illuminating methods, if it is not impracticable, by preparing a quickly drying white material which the miner could smear over the coal face at which he is working, and so obtain the full benefit of such light as he possesses.

FRANK ALLEN.

Department of Physics,
University of Manitoba,
Winnipeg, April 16.

Variations in Sex Expression in *Ranunculus*.

WE have now been working on problems connected with andrœcial and gynæceal variation in *Ranunculus* for several years and wish to supplement the remarks by Mr. J. Parkin in his letter published in NATURE of April 13, p. 568

Plants of *R acris* and *R bulbosus* with the stamens partially or entirely deficient in pollen production, and with correlated reduction in the size of the flowers, have long been known. There are many scattered references in botanical literature to this condition. Thus an interesting note on the subject was published in NATURE so long ago as 1878 (vol. 18, p. 588), and other references are given in Knuth's "Handbook of Flower Pollination", ii. 18, 24 (Engl. transl 1908) and by Sorokin, *Genetics* (**12**, 59, 1927) Varying grades of 'femaleness' were noted by us at Kew in 1914 in three species of the genus, but the War and accumulation of work immediately after prevented experiments being carried out, though one of us mentioned their occurrence in a paper published in the *New Phytologist* (**18**, 254, 1919)

We have found all grades between plants with completely hermaphrodite flowers and those with no functional stamens. The occurrence of every possible intermediate has made the work of scoring extremely difficult and, to a certain degree, arbitrary. On the other hand, our method of scoring led to Whyte's interesting and important discovery of the time-factor as a cause of the appearance of hermaphrodite or unisexual flowers. Little purpose can be fulfilled by giving a Latin name to the composite group of sex variations.

Mr. Parkin, rather surprisingly, does not refer to the living plant he kindly sent us. This was a male plant, in that all its flowers were, and have each season remained, functionless on the female side. It is the most interesting buttercup we have yet seen and it has been used in genetical experiments to

produce generations not yet scored beyond the F_1. The flowers have an increased number of narrow petals and, in general appearance, recall those of *R. ficaria*, yet it is certainly *R acris*. The plant has been multiplied vegetatively, and good specimens are preserved in the Genetical Herbarium at Kew. So far as we know it is the only 'male' *R. acris* plant ever recorded.

We are inclined to think that Mr. Parkin's suggestion that *R. acris* is in the incipient stage from hermaphroditism to gynædiœcism (or even to complete diœcism) is not improbable. We made a similar suggestion in a paper on the genetics of *R. acris* and *R. bulbosus* recently sent to press. Our field observations have proved that in some populations—widely scattered in England and Scotland—the percentage of female or intermediate forms is very much higher than one per cent, and in some counts it even approximated to fifty per cent.

Lastly, we wish to ask any reader observing sex forms or any abnormalities in any British species of *Ranunculus* to send us living specimens for genetical and cytological analysis.

E. M. MARSDEN-JONES.
W. B. TURRILL

The Herbarium,
Royal Botanic Gardens, Kew, Surrey,
April 27.

The Arc Spectrum of Phosphorus.

THE arc spectrum of phosphorus has been investigated by Saltmarsh and by McLennan in the Schumann region, and the lines belonging to the fundamental transition $2M_2(M_2 \leftarrow N_1)$ have been arranged according to Hund's theory by McLennan (*Trans. Roy. Soc. of Canada*, vol 21, sec. 3 , 1927).

The lines belonging to the second group of transition $2M_2(N_1 \leftarrow N_2)$ lie, according to the horizontal comparison method of Saha and Majumdar, in the region ν 9400-10300-10800 (*Indian Journal of Physics*, September 1928, p. 72). Similarly, the lines due to the transition $2M_2(N_1 \leftarrow O_2)$ have been located at 18000-20518.

The spectrum of phosphorus in the infra-red region has not yet been investigated, but as both silicon and sulphur are present in the sun, it was assumed that phosphorus should also be found. Taking the infra-red solar lines as given in the "Revision of Rowland's Preliminary Table of Solar Spectrum Wave-lengths," I located these lines with the aid of known differences $\Delta P_{1-2} = 151$, $\Delta P_{2-3} = 249$, in the regions predicted. The $4P - 4S_2$ lines and $4P - 4\bar{P}$ lines due to the transition $2M_2(N_1 \leftarrow N_2)$ have been found at $\nu = 10555$ to 11095. Attempts are being made to verify the identification by taking a spectrum of phosphorus in this region

The second group of lines, $2M_2(N_1 \leftarrow O_2)$, were identified in a group of lines obtained by Geuter in the region λ4600-6000, and have been identified with a number of faint solar lines. The identification seems to be unmistakable.

I have thus obtained two successive members of a Rydberg sequence, and calculated the ionising frequency to be $\nu = 86521$, corresponding to a voltage of 10·68 volts The ionisation potential of phosphorus is thus found to be slightly higher than that of sulphur, the element succeeding it in the periodic table. We have a similar case in nitrogen and oxygen

The investigation thus establishes the presence of phosphorus in the sun. D. G. DHAVALE.

Physics Department,
University of Allahabad,
Mar. 18.

An Optical Method for Analysing Photographs of α-Ray Tracks.

MR L. F. CURTISS, writing in NATURE of April 6, describes a method for examining stereoscopic photographs of α-ray tracks taken by two cameras at right angles The method which we have been using for some years for the measurement of the lengths and initial directions of emission of β-ray tracks (originally suggested to us by Prof. C T. R. Wilson) depends on the same essential principle as that described by Mr. Curtiss, and our experience confirms his observation of its accuracy and convenience. We described the method in a paper on "The Ranges of Secondary β-rays" (*Phil. Mag*, **2**, p 1110, 1926) as follows: "The lengths of the tracks were obtained from the stereoscopic photographs by replacing the photographic plates in the cameras, illuminating them and tracing out the common image which coincides in space with the original track". We have also used the same method in an examination of the initial directions of emission of photoelectron tracks (*Proc. Roy Soc*, A, **121**, p 612; 1928). In the case of observations with β-rays, since the track is not in one plane, the use of the translucent screen (as described by Mr. Curtiss for α-rays) is not applicable

In our experiments the axes of the two cameras were not at right angles, but were inclined at a small angle of about 20°. With this arrangement it is possible to *see* the track in stereoscopic relief, if, instead of holding a screen in front of the camera, we look through one lens with the right eye and through the other lens with the left eye. In actual practice this greatly facilitates the measurement of the tracks. A fuller account of the method will shortly be published elsewhere.

J M NUTTALL.
E. J. WILLIAMS.

The Physical Laboratories,
The University,
Manchester.

Geotropism and Antennæ.

I HAVE just been listening to a discussion, at the Zoological Laboratory, arising from some interesting observations by Mr G. L. Clarke on the tropisms of *Daphnia*. A question was asked as to the conceivable mechanism of geotropism in an animal very little heavier than water and with no air-bladder, and an expert in crustacean appendages suggested that, as the animal slowly sinks, fine sensory hairs on the appendages are bent upwards.

It has since occurred to me that, when passively extended, *Daphnia's* two swimming antennæ, branched and set with long fern-like bristles, will offer relatively great resistance to movement downwards through the water, a resistance on a long lever which must be met on the short internal arm of the lever by at least ten times the force in the muscle or ligament involved.

The actual stimulus for geotropy (positive or negative) might therefore be either an increase in tone of the lower muscles of the antennæ, or a decrease in tone of the upper muscles. If this hypothesis be considered plausible, we have an explanation why nauplii and copepods have evolved these two disproportionately long swimming-arms, in place of being content with the series of short equal paddles or cilia which suffice for so many other organisms. It is no longer remarkable that the most prominent swimming organ of the larva should be an important sense-organ in the adult decapod—for it has always been a sense-organ.

GEO. P. BIDDER.

Cambridge, May 1.

Science and the Classics.[1]

By Prof. D'ARCY WENTWORTH THOMPSON, C.B., F.R.S.

IT has been the rule from time immemorial, not the exception, for science and the humanities to go hand in hand. Aristotle the naturalist wrote of poetry; Plato was a lover of astronomy; Theophrastus the botanist was a master of rhetoric, whom even Cicero admired; Celsus the physician was an encyclopædic scholar after the taste and fashion of his age. When the humanistic tradition was at its height in the 'revival of learning,' Galen and Hippocrates were read by all. Linacre the physician helped to bring Greek into England, and was one of the great scholars of his time. Moreover our physicians have never lost but have richly inherited and enjoyed the classical tradition; Payne and Greenhill, Osler and Clifford Allbutt in our own time, were scholars after the manner of Haller and Boerhaave and Richard Mead and Sir Thomas Browne. Cuvier, busiest of men, wrote a commentary on the natural-history books of Pliny. Linnaeus himself could write of Nature with a scholar's pen and look upon her with a poet's eyes: the severe "Systema Naturae" was the work of one who fell on his knees when he beheld the sunlit gorse at Hampstead, and apostrophised mother Nature in words which sound like the echo of an Orphic hymn: "Natura, Filia Dei, rerum omnium Magistra, autodidactos, indesinenter laborans, nunquam festinans," etc.

If a man's mind be open to the influences of culture at all, he finds not a little of it within the range of his own profession, even though it be a technical one. My own science of zoology looks a very different thing at my age from what it did forty or fifty years ago. Around its bare facts have grown the stories and associations which travel, friendship, reading have supplied. Loose threads have woven themselves into a web. A fact discovered yesterday is balanced by the history of two thousand years. Knowledge is no longer something learned in the study, but that is imbibed during one's wanderings through the world; not something which is contained in a book or books, but which in all lands and languages is part of the living speech and daily business of men, part of the common birthright of mankind.

The faculty of weaving wider and wider associations around our work and thoughts, and of thus enlarging the horizon of our minds, is helped by that sympathetic attitude and spirit of which a broad education has laid the first foundations. But again, the Muses are often kindest to those who have worshipped little at their shrine. It is common nowadays for clever schoolboys to spend many hours of every day in a chemical laboratory, from the age (say) of fourteen: an age at which we were learning Greek, and Plato's young Athenians were playing on the lute. It might be supposed that our young chemists were laying up for themselves what Talleyrand called "une triste vieillesse". By no means. So wonderful a thing is a schoolboy, such a piece of work is a man, that our schoolboy-chemists are little the worse of their narrow and eccentric education. The learned chemist is still a learned man; in love and knowledge of the arts the chemists are scarcely beaten by the scholars. Not a few are steeped in the romantic history of their science, know what is to be known of ancient Greek and Egyptian chemistry, search out the medieval secrets of the poisoner, the alchemist, and the magician, and are versed in the Arabic and other recondite languages in which so many secrets are hid.

If it be an attribute or an end of culture to find something which shall take us out of our narrow lives, help us to forget the routine of our employments, and bring us in touch with the wide world, old and new, near and far away, to read history and poetry is a simple and time-honoured way; nor is there better history or poetry than that which the dead languages enshrine. Men who love these find them very helpful; they enable young men to see visions, they help old men to dream dreams.

A few months ago a scholar died, full of years and of honour, in whom science and the classics were very perfectly combined. Sir William Thiselton-Dyer was the acknowledged head of English botany; as botanist and gardener his influence went out into all lands, to the benefit of mankind, from the garden where he had the happiness to dwell; and all the while he was a true scholar, a Hellenist, acute, fastidious, and profound.

Thiselton-Dyer learned his Greek and Latin in a London day-school; so did I mine in Edinburgh—in that *Schola Nova* of Dunedin where my father had taught R. L. Stevenson and Andrew Lang and many another; had read the whole Aeneid through with them as beginners, and told them they were the first child-mariners who ever circumnavigated that noble poem. In seven years at school I never had a lesson in science, nor yet, I believe, had Dyer; but he and his companions, and I and mine, were botanists and naturalists in our teens. It was a Golden Age, when there were no scholarships to win, no examiners to satisfy. We had freedom to follow our bent, and leisure in which to teach ourselves.

If there was one school-book which Thiselton-Dyer loved more than another it was Virgil's "Georgics". Virgil never fails us, nor wearies us, nor does custom stale his infinite variety. The schoolboy thinks the "Georgics" an easy book; the old scholar knows it to be hard, finds in it *semper aliquid novi*, and is tantalised and fascinated by its difficulty. There is a line near the beginning about the "slow months" of the year, wherein Augustus found his heavenly habitation: "Anne novum tardis sidus te mensibus addas?" Halley the astronomer, coming to Martyn's help, explained the line by the brief statement that "Leo, Virgo, Libra, and Scorpio are really of slower ascension than the other eight signs of the Zodiack; to which Virgil no doubt alluded." But scholars

[1] From the presidential address delivered to the Classical Association, Cardiff, on April 9.

have been slow to accept an interpretation which seemed, as it seemed to Heyne, more subtle than poetic, and Conington declares that *tardus* "need be no more than a disparaging epithet, intended to exalt the power of Cæsar, who is to speed the year"! Dr Fotheringham has given me a full explanation, on Halley's lines The 'months' are signs of the zodiac, or the corresponding spaces which the sun travels over in a month Owing to the obliquity of the ecliptic the signs, or the corresponding spaces of 30°, do not rise above the horizon in equal times The calculation is somewhat technical, but the result is, briefly, that in the year 35 B C and the latitude of Naples, the four signs above-mentioned took each about $2\frac{1}{2}$ hours to rise, while Aries and Pisces, at the other end of the scale, rose in about an hour and ten minutes In other words, the signs round about the autumnal equinox took more than twice as long to rise as those about the vernal equinox, and the middle of the four 'slow months' lay precisely between Virgo and Libra or 'the Claws',—"Qua locus Erigonen inter, Chelasque sequentes, Panditur"

Dr Fotheringham tells me another fact, which was quite new to me. namely, that what looks like, and is generally taken to be, a parallel passage in Manilius has an entirely different meaning. "Ne mirere moras, cum Sol adversa per astra Aestivum tardis attollit mensibus annum" This refers to the sun's 'anomalistic' motion, which is fastest at perihelion and slowest at aphelion; that is to say, in classical times it moved fastest in Capricorn and slowest in Cancer, and 'mensis' here means the monthly course of the sun Now it so happened that the three signs in which the sun moved slowest, Gemini, Cancer and Leo, were precisely those in which (and in which alone) the zodiacal figures were depicted with the head or front towards the east. So Manilius frames the conceit that the sun moves slowly because these *astra* are adverse.

The naturalist, the botanist, and the astronomer, when they betake themselves to the classics, strive continually to interpret them: as generations of their kindred have been doing for five hundred years Now and then a nail is set in a sure place; and the task continually advances, without ever coming to an end Some day, but not yet, Greece herself will help us Only of late has the botanist had a flora of Greece which he can depend upon, we are sadly ignorant of its fauna. We long especially for better knowledge of its vernacular names of beast and bird and plant and creeping thing, such as are proving of deep interest to the naturalist and the scholar in the multitudinous dialects of Italy.

The humblest task of the naturalist is the identification of species, but, both in biology and the classics, it lies at the root of the whole matter. If we do not know the flower of which a poet sings, we blur the outline of his picture and miss his most delicate allusions. You remember, in the "Oedipus Coloneus", how the clustering flowers of the narcissus, ὁ καλλιβότρυς νάρκισσος, spring up under the dew of heaven, and make the μεγαλαῖν θεαῖν ἀρχαῖον στεφάνωμα—the time-honoured garland of the Magnae Deae My brother of our Greek chair brought me the passage only the other day, to ask me what flower νάρκισσος was, I told him (to begin with) that it was a *narcissus*, which is to say, a daffodil But we may read, in the "Hymn to Demeter", how Proserpine was gathering narcissuses, when she, poor maid, "by gloomy Dis was gathered". I thought she had her little feet on the unbending corn, and poppies in her hair! How came she to be picking daffodils, when the autumn was come, and she must be stolen away and leave her earth-mother desolate and forlorn? The simple, pretty explanation is that we may find a tiny, late-flowering daffodil, Virgil's "sera comantem narcissum", growing in Greece and Italy, on the dry hills where there is no moisture but the dew; it flowers with the autumn crocus, Sophocles' χρυσαυγὴς κρόκος, and lasts until winter comes. Proserpine picked it with the last rose of summer and the crocuses, for her farewell nosegay, she took it down with her to Pluto's realm, and men call it her ἀρχαῖον στεφάνωμα

Our daffodils have little or no perfume But the old fifteenth-century traveller Busbequius, the same who brought the Constantinople Dioscorides to Vienna (which Sibthorpe went to Vienna to see), found our little autumn daffodil "miro odore fragrantem". When Proserpine picked her daffodil-nosegay, such a fragrant incense-smell went up that Heaven and earth and sea all laughed for joy.

κηώδει δ' ὀδμῇ πᾶς τ' οὐρανὸς εὐρὺς ὕπερθε
γαῖά τε πᾶσ' ἐγέλασσε, καὶ ἁλμυρὸν οἶδμα θαλάσσης.

We miss something, if we say that narcissus means a daffodil—and pass on!

One of my father's colleagues in Ireland was J. F. Davis, who edited the "Eumenides", he was a very learned but eccentric man Going home on one of my undergraduate vacations from Cambridge, I met Davis in a Galway street; who cried out from afar off—it was his only greeting: "*Can* you tell me what plant Pliny's *Cassia* really was?" It happened that a German scholar had lately declared "Quid Cassiae nomine veteres appellarint, nunquam divinabimur" Now when Virgil and Ovid speak of cassia, along with thyme and rosemary, they mean marjoram, and it is so depicted in the Vienna Dioscorides. Martial's *Cassia*, which was burnt for incense on a funeral pyre, was the Semitic name of a sort of cinnamon, brought home from India by the spice merchants Early commentators mix up the poisonous Italian spurge-laurel (a sort of *Daphne*) with both of these; and Pliny mentions them, all three If I had known as much as this fifty years ago, I might have given Davis a partial answer to his question. But Pliny also mentions a kindred spice or drug, an evil-smelling spikenard from the Ganges, which he calls *Ozaenitis* a word which one would never doubt came from ὄζειν, 'to smell', if one did not know that so obvious a *Volksetymologie* was almost certain to be untrue This strange name and substance Thiselton-Dyer has ingeniously explained.

If we enlarge our knowledge of ancient geography by the help of Greek and Arab geographers, we may

follow, with delight and wonderment, the old trade routes known to Sindbad the Sailor, and to Solomon the King The Periplus of the Red Sea leads us by one of these straight to the ancient city of Ozene, an entrepôt of the spice merchants It has changed neither its name nor its commerce , it is the rich city of Ujjain, in Gwalior, the busy centre of the Indian opium trade Dyer had the acumen to detect that *Ozaenitis* was spikenard from Ozene , just as in Dioscorides, *Mossulitis* was *Cassia* from Mossylon, the ancient haven hard by Cape Guardafui where the spice-merchants landed their costly bales —the " aromaticae species quas mittit Eous ".

When Carlyle was old he wished they had taught him the constellations when he was young, and " made him at home in the starry heavens " , and I too wish I had learned as a child to read the picture-book of the sky It is an infinitely noble and exalted theme. It was the first art which grew into a science in the hands and minds of men Some say it gave mankind a first glimpse of the divine ; by man's soul and by the stars of heaven Sextus the Mathematician declares that Aristotle found his way to God ; and it is written that the firmament showeth his handiwork. The Greeks covered the sky with fairy-tales—" fabulis Graii complevere caelum," said Martianus Capella ; and Quintilian declares that no man can understand the poets if he be ignorant of astronomy—" nec si rationem siderum ignoret, poetas intelliget "

On the threshold of this delightful study we are met by the cardinal fact that the panorama of the heavens is continually but very slowly changing , so that the heavens of which Aratus tells are not our heavens, and Homer's pictures of the sky, though they are exquisitely true, are no longer to be seen by mortal men. For the heavens have their Great Year, in which each month of the twelve is 2000 years long, and a single day is threescore years and ten Some hold this to be the true theme of the Fourth Eclogue The Great Year, the Old Year, is drawing to its close when " Ultima Cumaei venit iam carminis aetas " , and anon, when " incipient magni procedere menses ", the Great Year begins anew. The Great Year and the precession of the equinoxes by which it is explained are doubly and trebly interesting to the classical scholar. Its discovery is commonly attributed to Hipparchus, and constitutes his title to immortality; this is a crucial argument of those who hold that the Greek genius was alone capable of transmuting crude barbarian knowledge into true science and wisdom. But the Assyriologists have lately found that this palmary discovery was made, at least essentially, two hundred years before Hipparchus, by Kidinnu, Pliny's Kidenas, of Sippur in Chaldea , and the Babylonian astronomer has his place henceforth among the greatest of men.

Ulysses leaned on his long oar and watched the Pleiad and Bootes and the Bear—Bootes who sets so tardily, and the Bear who turns and turns about, and glares upon Orion, and never dips his feet in Ocean's stream. But we who know that the Bear never sets in our northern sky, are surprised to find him setting like other stars, and by no means ἄμμορος ὠκεανοῖο λοετρῶν, when we go to the Mediterranean or the Aegean It is many a day of the Great Year since the Bears went dry-shod over the Aegean , but to tell just when they last did so is a simple matter, in the art or science of astronomical chronology The Bear was ἄμμορος λοετρῶν ὠκεανοῖο in the Mediterranean about 800 or 900 B C , and for some centuries before Homer tells us that on the night in question Bootes, Orion, and the Pleiad were all visible together , and we may take it for granted that they formed a notable configuration, the place and season of which men were accustomed to observe Ulysses was *navigating* by the stars , but why mention so many stars for such a simple thing ? We glance nowadays up at the sky, find the Pointers, and follow them to the Pole-star in a moment But in Ulysses' time there was no pole-star, nor had there been one for hundreds of years !

Greek mariners steered by the Great Bear, and Tyrians by the Little Bear, but both alike were makeshifts, for neither Bear stood at the pole and neither could stand still Only in some particular position would either of them give the true north, and that position must be defined by other stars. Suppose Ulysses out a-sailing one October night, about a thousand years before the coming of our Lord , a little before the dawn he saw Arcturus and the Pleiad, balancing one another as it were, one hanging above the eastern horizon, the other over the west Down in the south-west Orion was shining, the Bear was watching him with his two bright eyes , just then these two eyes (which we call the Pointers) lay one to one side and one to the other of the meridian , and the Bear himself, body and tail, stretched away into the north-east from this meridian line Ulysses looked at the Pointers and knew he was facing to the north , he then kept the Bear on his left hand, in the position in which *it then was*, and so steered to the south-west He was on his course to Scheria

The distinction between science and the classics vanishes away when we come to history, archæology, or folklore, wherein the object of our study is mankind Andrew Lang and a few others began to show us, a generation ago, how there was a science in the homeliest words and things, and the spirit of history in a game, an incantation, or a toy. In the " Pharmaceutria " of Theocritus we used to think the magic bird and magic wheel mere witchcraft, superstition, moonstruck madness—nothing more Then came Andrew Lang and the others, to show the wealth of meaning in these unconsidered things We have learned that the wheel still hums in the little hands of a Sicilian child , and that a kindred wheel roars its dull note in the hidden rites of the Australian bush It thundered in the horrid feasts of Cretan Zagreus , it sounded amidst the roll of drums, as in darkest Africa, for Rhea and Bendys and Cotytto Jason had it of Aphrodite, to bewitch Medea The Sicilian calls it a cicada , the Greeks knew it by a bird's name All the Orphic mysteries, and who knows what more out of the dark religions of the

East, lie behind the story of the girl who sat under the Lady Moon a-singing "Turn, wheel, turn, and fetch my own lad home to me"

When my father was writing of the dead languages, a dead civilisation had been but recently revealed, the chance-directed efforts of a traveller had shown the world that Nineveh and Babylon were "seats of tranquil learning and treasured science before ever a fleet had sailed from Aulis, or the eagles had promised empire to the watcher on the green Palatine" More than once since then has discovery repeated herself, raised up the ghost of empires which had gone down into the pit, and called from sepulchral palaces the long procession of the dead To learn what Greece had of her science, her religion, her mysticism, her genius, her language, and her blood, from the civilisations by which her own was encompassed and preceded, is to my mind the greatest puzzle of history, the noblest problem for the scholar. Were I a younger man I should want above all things to know Egyptian, Assyrian, and Hittite, and all the rest of that pre-Hellenic apparatus of the scholar which the last century has half-revealed I have been dreaming all my life of the riches of this Promised Land, a few grapes have been brought me from Eshcol—but I am come no farther than Mount Abarim.

When the wind blows from Assyria, it brings not only odours but also stray whispers to our ears. We remember how in the comedy of the "Birds" the two Athenians who pass by the hoopoe's dwelling on their way to the building of Cloud-Cuckoo-Town, come laden with basket, earthen pot, and myrtle-twigs

"Trudging along with basket, pot and myrtle,
To find some quiet easy-going spot,
Where we may settle down, and dwell in peace"

The scholiast, with the ignorance of his kind, explains this paraphernalia as so many useful implements for scaring away the birds But now we learn that in an Assyrian text, from the library of King Assurbanipal, precisely these three things, a box (or basket), an earthen pot, and a myrtle spray are named, in the self-same order, as sacred utensils, to be used in connexion with *the founding of a city*. Such is the ray of light thrown by modern archæology on a single and apparently insignificant line!

"Caput inter nubila condit"—"her head is muffled from our sight"—was said of antiquity, as also of fame, and scholarship, like science, has her secrets to discover and her mysteries to explore

Whether we be taught science or the classics in our boyhood is not the last word of all But whichever of the twain it be, let us so learn it as to love it, and so love it that we may love it to the end·

ἃ δ' ἂν μάθῃ τις, ταῦτα σῴζεσθαι φιλεῖ πρὸς γῆρας·

Science and the classics! The one says (in Wisdom's words): They that eat of me shall yet be hungry. And the other says They that drink of me shall yet be thirsty. And both alike continually enlarge our curiosity, and multiply our inlets to happiness.

The South Africa Meeting of the International Geological Congress.

THE High Court of geological opinion met for the first time in 1878 at Paris, with a membership of 310 Since that year there have been thirteen meetings, held at intervals of three years or so, at various capitals or other centres in Europe as well as in North and Central America, the long interval of nine years which separated the twelfth meeting in Canada during 1913 from the thirteenth session at Brussels in 1922 was due to the War and its aftermath

The present century is witnessing a remarkable extension—in theory and practice—of the principle of internationalism in many branches of human endeavour, of this the pages of NATURE afford ample evidence For the geologist extensive travelling is indispensable, and this is reflected in the steady growth in the number of those attending the sessions of the Congress, the record gathering of 742 geologists, representing some forty different nationalities, is a striking testimony of the extent to which world co-operation has grown in this science

For its fifteenth session, the Congress meets during the last week of July and during August of this year in South Africa at the invitation of the Government of the Union, with its headquarters at Pretoria The practical support from the Government as well as from the mining industry at Johannesburg and Kimberley, from municipalities and other public bodies and from various generous friends, has made it possible to arrange an attractive programme. This is the first occasion on which the Geological Congress has met in the southern hemisphere, and the exceptional opportunities which South Africa offers for the study of many fundamental problems of geology will make a strong appeal throughout the geological world Though the Union of South Africa is not yet known with a degree of detail comparable with that reached in some older countries, where geological investigation—both official and private—has been carried on for much longer periods, enough has been accomplished to allow one important function of the Congress—the examination of the outstanding geological features of South Africa—to be carried out with profit and interest to the visiting members Unfortunately, the great distances involved make heavy demands on the geologist's time and purse, but the efforts of the organising committee have met with a considerable measure of success, so that substantial concessions have been granted by the steamship lines and the South African railway administration.

The first main object of the Congress—to take stock of recent advances in geology—has, in accordance with the excellent practice established at previous meetings, enabled certain subjects to be placed in the foreground of the discussions The

important results that this excellent policy promises may be illustrated in the classic symposium on the origin of crystalline schists, which makes the *Comptes rendus* of the London Congress in 1888 such a valuable record to the student of rock genesis Almost all the special topics set down for the meeting in South Africa clearly reflect several of the particular features in which the geology of that country deserves the special attention of the Congress: Magmatic differentiation, pre-Pleistocene glacial periods, the Karroo System, its stratigraphy, palæontology, and world distribution; to these, rift valleys, the genesis of petroleum, and the geological work of micro-organisms have been added by special request

Probably nowhere in the world are the phenomena of magmatic differentiation more superbly displayed in extensive outcrops than in the unique igneous complex of the Bushveld, a petrographical province covering more than 16,000 square miles of country and including rocks that range from granite through norite and various ultrabasic types to massive segregations of almost pure magnetite and chromite, frequently alternating with bands of that remarkable group—the anorthosite Needless to say, this almost inexhaustible field of study long ago attracted the attention of the South African geologists—of whom Molengraaff, State geologist of the former South African Republic, was the first to recognise the genetic connexion between various members of the Complex By 1922 the more systematic survey of the Bushveld had advanced sufficiently to induce Prof R A Daly to organise a Shaler Memorial Expedition to South Africa, with the special object (amongst others) of examining what Daly and Molengraaff describe as "the largest and most remarkable igneous complex yet mapped"

South African geological literature has been enriched by two most valuable contributions from the members of this expedition, in the first Prof. Daly and Prof Molengraaff discuss the structural features of the Bushveld Complex (*Journal of Geology*; 1924), while in the second (*Bull. Geol Soc. of America*; 1928) Daly gives a brilliant analysis of the petrographical and chemical aspects revealed by the major phases of the Complex The long excursion after this summer's session of the Congress, specially devoted to the Bushveld, follows closely the route traversed by Daly and his friends, and the membership already secured promises not only valuable and profitable results, but certainly also a stimulating experience for the South African geologists concerned It need scarcely be said that the curious occurrences of primary deposits of platinum, for which the Complex is gradually assuming great economic importance, including those strange and unique vertical 'tubes' of dunite, are not to be overlooked on this excursion

Since the days when Sutherland in 1868 first recognised the glacial origin of what is now firmly established as the Dwyka conglomerate, the study of pre-Pleistocene glacial periods has made great strides, both in South Africa and in the other continents, where Permo-Carboniferous glaciation is in evidence, and a special excursion will give a glimpse of the stupendous glacial activity which has left us with the remains of ground moraine spread over more than 17,000 square miles, and demonstrate the superb striated floor, etc., of this Dwyka conglomerate, for which the Kimberley neighbourhood has become so justly famous, that one might call that region the glacial geologists' National Park

Apart from the Permo-Carboniferous, South African geologists have recognised four other pre-Pleistocene glacial periods, all of which are older than the Dwyka In this recognition the late Geological Commission of the Cape of Good Hope has taken the principal part One of these can be traced in the glacial conglomerate of the Table Mountain sandstone of the Cape System in the Cape Peninsula, etc Another is found in the Lower Witwatersrand System in the Heidelberg area, while a third is reflected by the tillite, in the Griquatown Series of the Transvaal System (N W Cape and Central Transvaal) The fourth period is that of the Numees Series in Namaqualand An examination of the majority of these glacial deposits is included in the programme of excursions and no doubt will furnish much material for interesting and helpful discussion

No apology is needed for selecting for discussion at a meeting in South Africa the stratigraphy, palæontology, and world distribution of the Karroo System, which is *par excellence* in that sub-continent, covering approximately one-half of the Union of South Africa, with its rich reptilian fauna and instructive fossil flora, with which geologists have become familiar through the researches of Broom, Haughton, Du Toit, and others It is to be hoped that the palæontologists will not miss examining the exceptionally fine type collections of Karroo fossils which form a recognised feature of importance in the South African Museum at Cape Town. The Karroo stratigraphy, etc (including the profuse sills of dolerite), with some of its organic remains, will receive special attention on the Cape-Kimberley, Port Elizabeth, and Durban-Zululand excursions, the first named also covering good fossil localities of the (Devonian) Bokkeveld Series of the Cape System.

A discussion on rift valleys is most appropriate to the venue of this Congress, it is obviously a branch of tectonic geology of far more than local interest, and its inclusion by special request on the part of those closely identified with this line of research is to be welcomed—no less than the offer by one of the latter to invite a symposium on this subject by means of an illustrated lecture

For the second main object of the Congress—a study of the geology of the country visited—the organising committee has evidently felt—and we cordially endorse its view—that in a country relatively so little known to geologists outside South Africa, a large and varied series of excursions would make a special appeal, and a study of the programme shows that in this respect the fifteenth Congress should certainly constitute a record, since the twenty-two excursions extend from Cape Town in the south, northwards to Elizabethville in the

Congo, and from Luderitzbucht on the Atlantic to Durban on the Indian Ocean, forming a network of journeys that cover an area one-third the size of Europe! Yet this comprehensive programme is so skilfully worked out that every member has an opportunity of taking part in a large proportion of the excursions These range from half a day to twelve days—and they study not only the taste but also the purse, while their scientific success should be assured when one glances at the names of the leaders Among the outstanding geological features to be visited are the Victoria Falls (with their fascinating physiographical history), the Bushveld Complex, the Karroo, the Great Eastern Escarpment of the Drakensberg at the Devil's Kantoor (the magnificent scenery of which has made this a classical spot for studying the tremendous physiographic contrast in the relationship between the Central Plateau and the coastal belt), the Zululand Cretaceous Beds, and the unique Vredefort Dome, where a central granite is surrounded by a girdle of sediments showing an inversion of the succession through thousands of feet of thickness, and associated with an almost incredibly intense metamorphism. Through the published work of Molengraaff, Hall, and Nel, much detailed information on these extraordinary phenomena is available Of the various occurrences of alkali rocks, the programme provides a visit to the Franspoort bodies near Pretoria, the alkali-granites and canadites round the Vredefort Dome, as well as the Pilandsberg (with its remarkable ring inclusions)—the largest alkali mass yet examined in detail, which has recently been described by Shand (*Transactions of the Geological Society of South Africa*, 1928)

Economic geology naturally has a prominent place in the programme: the Kimberlite diamond pipes of Kimberley and the Premier Diamond Mine (whence came the largest diamond on record), the Witwatersrand with the world's most important goldfields, the primary platinum deposits of the Bushveld, the remarkably rich asbestos mines near Barberton, the rare chromite occurrences in the Bushveld Complex, the ore deposits and peculiar desert geology of South-West Africa, including the mineralogists' well-known hunting ground of the Tsumeb lead and zinc mines, and last, though certainly not least, the copper-bearing regions of Northern Rhodesia, now recognised as a most important asset in the mineral resources of the British Empire

The Congress has also begun the practice of setting aside for special study the world's resources in certain types of ores—for example, iron, coal, pyrites—and the resulting volumes remain a handsome testimony to the foresight of the Congress. No happier choice could have been made for the South Africa meeting than the subject of the "Gold Resources of the World"

The recent publication by the Geological Survey of the Union of a map on the scale of one in a million, also the latest volume (written by some members of that Survey) in the well-known series of the "Handbuch der regionalen Geologie", dealing specifically with the Union, will be much appreciated by visiting geologists in particular For those who may want to take in a wider field there is the admirable volume by Du Toit on "The Geology of South Africa".

The almost simultaneous meeting in South Africa of the British Association, under the presidency of a distinguished geologist, Sir Thomas Holland, and the useful measure of co-operation with the Congress, arranged for at Johannesburg and Pretoria, will render 1929 a memorable year in the history of geology, while the gathering of the world's geological clans in that sub-continent may well repeat the truth of the well-known phrase "Ex Africa semper aliquid novi". A L H

Obituary.

THE MAHARAJ RANA OF JHALAWAR.

THE announcement in NATURE of April 20 of the death of the Maharaj Rana Bhawani Singh of Jhalawar while again on his way to Europe recalls the fact that, of those with whom he was associated in previous visits, too many would not have been here to welcome him He would doubtless have missed especially Sir James Dewar at the Royal Institution, Prof A. D. Waller at the Physiological Laboratory in the top story of the University of London, Sir Archibald Geikie, president of the Royal Society at its 250th anniversary, which the Maharaj Rana attended as a delegate from India, and besides those, Miss K. Stephen, principal of Newnham, in 1912, and the presidents of the meetings of the British Association, Sir William Herdman at Cardiff in 1920, Sir Edward Thorpe at Edinburgh in 1921

The Maharaj Rana's first visit to Europe in 1904 furnished material for a book of travel pictures, published in 1912, when he came to England for a long stay with a suite of court officials in attendance, among whom, the Pandit Shyam Shankar was indefatigable in providing opportunities for the acquirement of knowledge of the West and the diffusion of knowledge of the ways and customs of the East

Meteorology was one of the sciences that caught the Maharaj Rana's attention He became a familiar figure at meetings of the International Commissions for Maritime Meteorology and for Weather Telegraphy which were held in London in September of that year It was an interesting time, because telegrams from Iceland, wireless telegrams from ships, and an international code for gale warnings were on the agenda papers The Maharaj Rana acknowledged the courtesy of the Commissions by a stately dinner, at which, with other novelties, the members with their ladies were initiated in the parting ceremonies of garlands and attar of roses.

A visit to Cambridge in the same year provided the experience of luncheon and the gardens at Newnham College, with an exchange of civilities

between potentate and student by the aid of hand cameras: then dinner in a college hall and the cultured serenity of the combination room, so impressive as to suggest that two or three years at an English university would form the proper completion of the education of the heir to a throne. In 1920 that idea found expression at Oxford Kumar Rajendra Singh, recently married to the daughter of the Maharaja of Vizianagram, went to Christ Church, and the Maharaj Rana enrolled himself at New College. Apart from a short return home in 1921, he lived in Oxford for two years, but he was always to be found at the lectures of the Royal Institution The British Association, the Royal Sanitary Institute, the Royal Aeronautical Society, and again, whatever was going on at the Meteorological Office, engaged his attention, including another meeting of the International Commission for Weather Telegraphy His part in the many scientific meetings which he attended was mainly to listen and appreciate. Conversation was favoured as a mode of expressing himself, rather than writing or speechmaking, in that and in his letters he was invariably alert and precise

The *Times* of April 15 gave a striking account of the character and achievements of the Maharaj Rana as a ruler Others will cherish the remembrance of a genial and enthusiastic student of Nature and art As a Rajput his traditions and reminiscences were of military prowess and achievements with the bow As one condoles with the new Maharajah on the loss of his father, it is impossible not to wonder what would happen if the Indian princes betook themselves to the conquest of the secrets of the Nature that surrounds them; if they should turn their swords into tuning-forks and their arrows into sounding balloons NAPIER SHAW.

SWEDISH zoology has sustained a serious loss in the death of Prof Nils Johan Teodor Odhner, which occurred at Stockholm on Oct 29, 1928. Prof Odhner was born at Lund in 1879. Graduating at the University of Uppsala, he became lecturer in zoology at that University In 1914 he was nominated as professor of zoology in the University of Oslo (Norway), and four years later he became *Intendant* of the department of invertebrates in the State Museum of Natural History in Stockholm. Prof Odhner's zoological work consists principally of systematic and faunistic papers on the Trematoda, upon which group of animals he had been for many years a leading authority. He also devoted some time to the study of certain groups of Crustacea. His activities were not, however, confined to zoological research His wide social interests and energetic contribution to the intellectual life of his country are manifested by the various official positions which he occupied—as a delegate to the League of Nations, president of the Sweden-Finland Foundation, and vice-secretary of the Swedish Academy of Science. As a speaker and writer he contributed much to the popularisation of his own branch of science.

WE regret to announce the following deaths:

The Right Hon. the Earl of Rosebery and Midlothian, K.G, K T, F R S., Chancellor of the University of London, who was elected to the Royal Society in 1886 under Statute 12, which permits of the election of persons who "either have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the Society", on May 21, aged eighty-two years.

M. Emile Chaix, professor of physical geography at the University of Geneva, aged seventy-four years.

News and Views.

THE most important legislation affecting the welfare of migratory birds, since the Migratory Bird Treaty Act of 1918 between the United States and Canada, was passed by the U S. Senate on Feb. 11, and signed by President Coolidge on Feb. 18. This was the Norbeck-Andresen Migratory Bird Conservation Act, which has been fought for eight years in eight sessions of Congress, and finally succeeded when the matter of a Federal license, to which objection had been taken, was omitted from the Bill The Act is a direct sequel to the Migratory Bird Treaty of 1918, for it was found that, useful as that Treaty had been, much of its potential value seemed likely to be lost if provision could not be made for a system of refuges or sanctuaries in the areas traversed by the birds in their migratory flights, and on their wintering grounds. The purchases of such reserve areas demanded large sums of money, and it was to meet this outlay that the Federal license, which proved to be the stumbling-block of the original Bill, was proposed. The difficulty of finance has been removed by proposed State grants. Although the Act makes no appropriation, it authorises a schedule of appropriations amounting in all to some eight million dollars, and settling down after ten years to an annual sum of 200,000 dollars. The first year's sum of 75,000 dollars is to be devoted to a survey of the area to determine the places best suited to become bird-refuges, and, this completed, the selected areas will be purchased and henceforth guarded by an appropriate staff The American Game Protective Association, which has strongly advocated the proposals of the bill in its bulletin, *American Game*, is to be congratulated on the success of its campaign.

A SPECIAL type of rubber made by the Expanded Rubber Co., Ltd., Wembley Park, and marketed under the trade name of 'Onazote', which appears to have many uses in science and technology, has recently been mentioned in the Press. Onazote is essentially a very spongy form of rubber prepared by vulcanisation under high gaseous pressure, which is sometimes as high as a hundred atmospheres. During the cooling process the pressure is gradually reduced, with the result that the occluded gas expands, forming pockets of air enclosed in thin rubber membranes. Onazote can be prepared with a variety of physical properties by suitably varying the process of preparation. In particular, it can be produced in a hard

form not unlike ebonite in external appearance, and in a soft pliable form. In each case the fine cellular structure is of course retained.

THE material has a remarkably low specific gravity of the order 0 076 to 0 102 (that is, it weighs 4½-5 lb. per cubic foot), and the hard variety is stated to be practically impermeable to water. The soft form combines low density with high resiliency, and tests indicate that after the removal of the compressing load the sheets return practically at once to their initial thickness. As may be conjectured from its physical nature, onazote has a very low thermal conductivity. The value of this constant as measured on a sample at the National Physical Laboratory is 0 00008 gram-calories per square centimetre per second for 1 cm. thickness and 1° C. difference in temperature between faces. It is suggested that the material may have a variety of uses. Its lightness and non-absorbent properties render it suitable for life-belts and floats, and its resiliency suggests its possibilities in making shock-absorbers, cushions, and allied articles. It is also claimed to be of use as a sound absorber for making silence cabinets and improving the acoustics of buildings. The hard variety has electrical properties akin to ebonite but without the brittleness of ebonite.

THE problem of distributing the white population of the British Commonwealth in the most efficient manner as between all its parts, is the object of the various schemes of Empire settlement which are included in the Report of the Oversea Settlement Committee for 1928 (London. H.M. Stationery Office, Cmd. 3308). Among the many problems on which the report touches is that of the checks on this desirable redistribution of population These are many, and include, in Great Britain, the industrial habits and townward bent of the population and its unfitness and unwillingness to settle on the land, the upward tendency of the standard of living, the effect of schemes of social insurance which tend to anchor population and decrease its mobility; and the fact that the spirit of emigration becomes evident when the population is prospering and not in times of adversity In the Dominions, there are also certain factors that check the flow of population from the home country The call for population does not necessarily bear relation to the conditions in Great Britain and the need for emigration. The Dominions want mainly agricultural workers and, among women, domestic workers, while the need for emigration is chiefly among the industrial workers. The growing tendency of all the Dominions to make a more and more vigorous scrutiny, in the interests of racial fitness, of all who wish to enter the territory, reduces further the flow of emigrants from Great Britain.

THE first conversazione this year of the Royal Society was held on May 15 in the Society's rooms at Burlington House. As usual, there were numerous exhibits and demonstrations representing recent developments in many branches of science, as well as instruments and photographs of historic interest Atomic physics does not easily lend itself to large-scale demonstration, but Prof. G. P. Thomson showed photographs from his work on the diffraction of electron waves, and Messrs Adam Hilger, Ltd., included in their exhibit one of Dr Jean Thibaud's X-ray grating spectrographs for soft X-rays. Applied physics exhibits included an instantaneous visual direct-reading radiogoniometer (Radio Research Station, Slough). Physiological apparatus included a moving iron oscillograph recording sensory nerve action currents (Mr. Bryan Matthews), and a portable electrocardiograph (Cambridge Instrument Co, Ltd.). Recent biological work was represented by exhibits of 'breaking' in tulips from the John Innes Horticultural Institution, plants toxic to insects (Rothamsted Experimental Stations), and several exhibits from the British Museum (Natural History). Prof. W A Bone and Mr. R. P. Fraser showed some remarkable photographs of flame propagation in gases, Sir Robert Hadfield specimens of various special steels, the Anglo-Persian Oil Co. an apparatus for the visual examination of oil being cracked under pressure, and so on. Twice during the evening Dr R G. Canti gave a kinematograph demonstration, consisting of consecutive series of photomicrographs, of living tissue cultivated *in vitro*. The film showed the processes of cell growth in the normal and malignant tissue: out-wandering of fibroblasts and wandering cells; the various stages of cell division including migration of the chromosomes; cell degeneration; phagocytosis. The last part of the film, which dealt with the fibroblast of the chick embryo under dark ground illumination, showed the internal structures of the cell.

AT the Friday evening meeting of the Royal Institution on May 10, Prof. A. E Boycott gave a fascinating account of the genetics of the mode of twist of the shell in *Limnœa peregra*, and illustrative collections were also on view at the Royal Society soirée on May 15. In the majority of species of snails the twist of the spiral is dextral, but in a few it is normally sinistral In many of the normal dextral species sinistral varieties occur, and vice versa, and these unusual forms occur either as odd sporadic specimens or else as an established component of the population. *Limnœa peregra* is normally dextral, and its sinistral variety is very rare—less than a dozen sporadic having been recorded In four ponds in England the population of dextral snails included a small proportion (·5 per cent or less) of sinistrals. Four of these sinistral individuals were used for experimental breeding work It was found that sinistrality is a simple Mendelian recessive which is inherited according to the usual plan, save that any change of twist imposed by crossing is delayed for one generation. The snail inherits not its own twist but the twist of its offspring, and segregation is by broods and not by individuals All inheritance in *Limnœa* is, however, not maternal. Albinism was found to be a simple Mendelian recessive, transmitted in a straightforward fashion. Sinistrality and dextrality are characters of considerable importance, for the reason that in the Helices, which are incapable of self-fertilisation, copulation is impossible between the two forms. The peculiar inheritance of shell twist

is due to the fact that this character is determined at the first division of the egg, soon after the entrance of the sperm, and the form of the division is determined by the constitution of the egg and the sperm does not effect it. Albinism, on the other hand, is a character which is not expressed until much later in development, by which time the contribution of the sperm has become effective.

THE speech delivered recently by Sir Robert Hadfield, as chairman of Hadfield's, Ltd, contained many points of special importance and showed the advances which the steel firms of Great Britain, including his own, are making. In connexion with the attempts now being made to foster a better spirit between employers and employed, it is of special interest to note that, so long ago as 1894, Sir Robert presided at a well-attended meeting of employers and labour representatives in London, when a body was formed to which the name of the Industrial Union of Employers and Employed was given. The body had objects in view of a similar nature to those now being formulated by the Melchett-Turner conference, and met with strong approval from many men of a more far-seeing character. Sir Robert remarks that, "Had the employers at that time taken the matter with the same heartiness, and given the same support rendered by the labour representatives to myself (the president) and the Council, I fully believe that this work would not have come to an untimely end and would have proved of great national benefit. I believe that the organisation then proposed would have gradually grown in importance and that much of the trouble since experienced . . . might have been largely avoided."

IN speaking of scientific research in Great Britain generally, and especially of research with a possible technical bearing, Sir Robert Hadfield made the following important observation: "It is most advisable that research work should be fostered in the various universities of Great Britain . . . Whilst we all recognise the splendid work done by the National Physical Laboratory, which is an exceedingly important organisation, these local centres must not be overlooked when monetary grants are being allocated. It is usually the local centres which best know the needs of the particular locality concerned. There is no reason why subventions or grants, whether from Government headquarters in London or locally, should not be freely handed over to our various local universities, thus locally stimulating and encouraging research, which is more than ever important nowadays." Interesting remarks were also made concerning the growth of the induction melting of metals and the new heat-resisting steels The advance made in the latter connexion is indicated by the example given of a steel heated to a temperature of 1200° C. for 21 hours which, after that very drastic treatment, was scarcely scaled at all.

ON Tuesday, May 14, the Prince of Wales formally opened the North-East Coast Exhibition at Newcastle-upon-Tyne. This great industrial exhibition, representative of the life and work of the north of England, has been organised and built in less than two years on a commanding slope on the Town Moor, and will remain open until October. Prominent features are the Palaces of Engineering and Industries, where the Tyneside manufacturers have made good use of the opportunity of showing the manifold activities of the industrialist corner of England. The Prince of Wales, who went to the Exhibition after opening the new department for mining research at Armstrong College, congratulated the promoters on the general lay-out; its aim, he said, "is to revitalise existing industries, to discover how they should be adapted, and, if necessary, improved". Scientific discovery linked with industry is well represented in the president of the Exhibition, Sir Charles Parsons, and it is in this direction that we must look for the adaptations and improvements visualised by the Prince of Wales and for new methods and new industries to enable the British Empire to maintain its place in the world's markets

THE Federation of Lancashire and Cheshire Museums, founded in January 1928, has issued a first annual report, which summarises very briefly the aims and accomplishments of the Federation. The object is the practical one of a more efficient museum service as between museums themselves and as between museums and the public, and the experiment will be watched with keen interest in the hope that it may contribute to the solution of the difficulties and staleness of the smaller local museums. The means adopted have been periodical meetings of museum curators and members of their committees, where subjects of practical interest are discussed, and a scheme for the donation, exchange, or loan of specimens between the federated museums. Twenty-three, out of a possible of thirty-eight museums in the two counties, have joined the federation, the meetings were reasonably well attended, and the exchange scheme has been made use of by thirteen museums There can be no doubt about the excellence of the federation idea; time will decide whether the museums themselves are enthusiastic enough and energetic enough to make it a success.

THE Imperial Bureau of Soil Science, one of the eight Bureaux the formation of which was recommended by the Imperial Agricultural Research Conference of 1927, commenced work on May 1 at the Rothamsted Experimental Station Sir John Russell, Director of Rothamsted, is also the Director of the Bureau, and Dr. A. F. Joseph, lately Sudan Government Chemist, has been appointed deputy director. The functions of the Bureau include the collection and distribution of all research work of importance on soils to the British Empire, the assistance of research workers in the prosecution of their investigations in whatever ways it can, the bringing together of workers from different parts of the Empire (either by correspondence or in conference) interested in the same subjects, and to supply information generally which may facilitate the work of soil experts in the development of agriculture. It is hoped that before long the Bureau will be in close touch with all soil investigators

of the Empire, both at home and abroad, and that by means of information-circulars and other methods, the results of studies carried on in one part of the Empire will be made available for all Arrangements will also be made to supply information dealing with soil investigations in foreign countries, the results of which, owing to language or other difficulties, are not readily available.

The Bohemian Academy of Sciences has recently issued its *Bulletin International* for 1926, containing in its 628 pages résumés in English or French of the papers communicated to the Academy during that year. These communications number nearly fifty, and cover the whole field of mathematical and natural sciences and medicine, and many, especially those dealing with biology, are illustrated with photomicrographs and other well-executed illustrations. This is particularly noticeable in the three coloured plates accompanying Dr. V. Breindl's studies of plasmodium, those with Dr J. Wolf's investigation of the genesis of collagen fibres, and those of Prof B. Němec and Dr. Milovidov on bacteria in plant and human tumours. There is a posthumous contribution from Prof J. V Daneš on the limestone physiography of the United States of America, and among a number of other geological papers are several by Dr. Petrbok on the stratigraphy of the Palestine palæolithic (the first containing 108 figures). In mathematics, Dr. V. Trkal has given a contribution to the dynamics of the neutral helium atom, whilst the *Bulletin* also contains Dr. Sobotka's deductions of certain polar properties in conic systems Chemical science is represented by papers on the radioactivity of potassium and rubidium (Miss Petrova), adsorption by colloidal carbon (Dr Podroužek), the electrolytic estimation of bismuth (A Jilek and J. Lukas), and a study of the pyrrolones (R Lukeš).

The only railway line laid across South America is the one joining Valparaiso and Buenos Aires, traversing both Chile and Argentina. It provides an overland connexion 840 miles long between the Pacific and Atlantic Oceans. It skirts the extinct volcano of Aconcagua in the Andes, and its maximum altitude is about 10,500 feet. The section of the railway from Los Andes to Mendoza is called the Transandine Railway. It is laid for a combined rack and adhesion service and has a metre gauge. The operation of this railway was rendered very difficult in winter by snowfalls, often 20 feet deep, and by avalanches of rocks. This necessitated extensive protective works and galleries. Owing to the soft coal used, thorough ventilation of the galleries was also necessary. This, and the fact that the coal used had to be raised to an altitude of nearly two miles against gravity, induced the directors of the Transandine Railway, which belongs to a British company, to adopt electric traction This enabled an increase in the speed and weight of the trains to be made. As the freight consists mainly of cattle from Argentina to Chile, and perishable fruit in the opposite direction, the increase in weight and speed has many advantages. A full technical account of this railway is begun in the *Brown Boveri Review* for April This company, in conjunction with the Swiss Locomotive and Machine Works at Winterthur, constructed the combined rack and adhesion locomotives which are used. These are the largest locomotives of this type that have ever been built. The brakes required for these locomotives are quite as important as the driving gear. The brakes for the adhesion driving wheels are of the Westinghouse compressed-air type. When the emergency rack brake is used the automatic brakes on both locomotive and train are applied simultaneously. The braking force on the rack sections at the wheel tread is 32 tons. The total continual electrical braking capacity is 456 horsepower.

Many accessions illustrating the historical development of the sciences were made to the Lewis Evans collection of the Old Ashmolean during the past year. They include a valuable series of perpetual calendars in various materials, a set of bronze facsimiles of previously unknown surgical instruments used in Pompeii in the first century, several important microscopes from the Crisp collection, and a refracting telescope of great historic interest, namely, the instrument used by the greatest of Oxford's astronomers, James Bradley, who himself lectured in the Old Ashmolean from 1729 onwards. The fifth Annual Report, for 1928, in addition to recording other gifts, directs attention to the need for treating the outer stonework of the building, which has not been refaced since 1679, and mentions a feature of the year which should be of great advantage to the development of the collections, namely, the foundation of a Society of the Friends of the Old Ashmolean. Previous to the annual meeting of this Society on May 4, Prof. D'Arcy W. Thompson delivered a public address on "The Hellenic Element in the Development of Science", to which reference was made in our issue of May 11, p 732.

The annual visitation of the Royal Observatory, Greenwich, will take place on Saturday, June 1

At the anniversary meeting of the Royal Society of South Africa, held on Mar 20, the following officers for 1929 were elected:—*President*. Dr. W. A Jolly; *Hon Treasurer*. Dr. L Crawford, and *Hon Secretary* · Dr. B F J Schonland.

The Council of the Royal Meteorological Society has sent a message of congratulation and good wishes to the Society's honorary member, Prof. Hugo Hergesell, on the occasion of his seventieth birthday, which will occur on May 29. We understand that addresses of congratulation will be presented to the veteran director of the Lindenberg Observatory by learned societies and official bodies in Germany in recognition of his services to meteorological science and its application to aviation.

An International, Colonial, and Maritime Exhibition is to be held in Antwerp next year in celebration of the Treaty of Belgian Independence. The British Empire will be well represented and the Treasury has sanctioned an expenditure of £100,000 on the exhibit.

The most important British shipping companies are to have displays in the British section, and manufacturers of equipment for ships, such as navigation instruments, etc., will be specially invited to exhibit.

AN International Photography Exhibition, to be held at Gothenburg on Oct. 15–31, is being organised by the *Goteborgs Handels- och Sjofarts-Tidning*. No entrance fees and no charges for return of exhibits are made. A special section of the Exhibition will be devoted to scientific photography. Correspondence concerning this section should be addressed to Dr. S. E. Ohlon. The honorary secretary of the Exhibition is G. F. Ahlberg, International Photography Exhibition, Box 52. Gothenburg, Sweden.

TOWARDS the end of last year a British committee representative of some twenty-six engineering institutions and technical societies was formed to organise a party of British engineers to attend the World Engineering Congress to be held at Tokyo on Oct. 29–Nov. 22 and to secure papers for presentation at the Congress (NATURE, Jan. 12, p. 62). Seventy-six papers have now been contributed dealing with railway and river engineering, strength of materials, alloy steels, aircraft, petroleum technology, chemical engineering, coal cleaning, town planning, illumination and photometry, etc. It is anticipated that a party of thirty-five to forty representatives of British engineering theory and practice will attend the Congress.

THE Council of the Institution of Electrical Engineers has made the following awards of premiums for papers read during the session 1928–29, or accepted for publication: The Institution Premium to Mr. Johnstone Wright and Mr. C. W. Marshall; Ayrton Premium to Mr. L. G. H. Sarsfield; Fahie Premium to Mr. A. E. Foster, Mr. P. G. Ledger, and Dr. A. Rosen; John Hopkinson Premium to The Hon. Sir Charles Parsons and Mr. J. Rosen; Kelvin Premium to Mr. E. B. Wedmore, Mr. W. B. Whitney, and Mr. C. E. R. Bruce; Paris Premium to Mr. J. L. Carr; Extra Premiums to Capt. J. G. Hines, Mr. B. L. Goodlet, Mr. L. H. L. Badham, and Mr. W. Phœnix; Wireless Premiums to Mr. T. L. Eckersley, Capt. P. P. Eckersley, and Mr. A. B. Howe; Mr. R. M. Wilmotte and J. S. M'Petrie.

AN expedition for the study of the behaviour of the mountain gorillas of Belgian Congo is announced in a recent *Daily News Bulletin* issued by Science Service, Washington, D.C. The expedition has been undertaken jointly by Yale University and the Carnegie Institution of Washington, by special arrangement with the Belgian government. Dr. Harold C. Bingham of Yale, a psychologist who has already carried out extensive studies on the behaviour of apes in captivity, will be the scientific representative of the two American institutions. He hopes to establish close and sustained contact with groups of mountain gorillas, to follow their movements day and night, and to observe their traits of behaviour in relation to species and varieties, their manner of life, and their distribution. The expedition will leave the United States in June and proceed by way of Dar-es-Salaam to the head of Lake Kivu, whence a trek of a hundred miles will take the explorers into the gorilla country.

THE fortieth Congress of the Royal Sanitary Institute is to be held at Sheffield on July 13–20, under the presidency of the Right Hon. Earl Fitzwilliam, who will deliver the inaugural address on Monday, July 15. Sir Allan Powell, chairman of the Food Council, will deliver the Congress lecture, taking as his subject, "Some Aspects of the Food Problem", and Prof. W. W. Jameson will deliver a popular lecture. 750 delegates have been appointed by 430 authorities in the British Empire and other countries. Among the subjects arranged for discussion are mental hygiene of the child and of the adult, health education, food hygiene, industrial welfare, smoke abatement, housing and regional planning, rivers pollution, and water supply. The Right Hon. the Lord Mayor of Sheffield, Alderman Harry Bolton, is the chairman of the local committee, and the Town Clerk, Sir William Hart, and the Medical Officer of Health, Prof. F. E. Wynne, are joint honorary local secretaries.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A headmaster of the Junior Technical Evening Institute, Shelburne Road, Holloway—The Education Officer (T. 7), County Hall, Westminster Bridge, S.E.1 (May 29). A teacher of building subjects at the Municipal Technical School, The Gamble Institute, St. Helens—The Secretary for Education, 17 Cotham Street, St. Helens (May 30). An assistant lecturer in electrical engineering at the Bradford Technical College—The Principal, Technical College, Bradford (May 31). A full-time teacher in the Mechanical Engineering Department of the Lincoln Technical College—The Principal, Technical College, Lincoln (May 31). Temporary posts under the Department of Agriculture for Scotland, namely, two investigators and an indoor assistant for work in connexion with an inquiry into marketing live stock and other agricultural produce in Scotland—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (June 1). A woman resident lecturer in geography and mathematics at the Bangor Normal College—The Principal, Normal College, Bangor, North Wales (June 3). An assistant lecturer in the Mathematics and Physics Department, The Polytechnic, Regent Street—The Director of Education, The Polytechnic, Regent Street, W.1 (June 3). A lecturer in mathematics and a lecturer in physics at the University College of Swansea—The Registrar, University College, Singleton Park, Swansea (June 5). A principal of Brierley Hill Technical Institute, Stafford—The Director of Education, County Education Offices, Stafford (June 5). Research chemists at establishments of the Department of Scientific and Industrial Research—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (June 6). A junior assistant (engineer) at the Fuel Research Station, East Greenwich—The Secretary, Department of Scientific and Industrial

Research, 16 Old Queen Street, S W 1 (June 6). A headmaster of the Junior Technical School, Ashton-under-Lyne—The Education Office, 8 Warrington Street, Ashton-under-Lyne (June 8) Clothworkers' Research Scholarship in the Department of Textile Industries, the University, Leeds—The Clerk to the Senate, The University, Leeds (June 8). A lecturer in metallurgy and assaying at the Manchester Municipal College of Technology—The Registrar, Municipal College of Technology, Manchester (June 13) A lecturer in physics at Christ Church, Oxford—The Very Rev. the Dean, Christ Church, Oxford (June 14) A lecturer and demonstrator in the department of physics of the Royal Holloway College—The Principal, Royal Holloway College, Englefield Green, Surrey (June 15) A lecturer in engineering and practical mathematics in University College, Dundee—The Secretary and Registrar, The University, St. Andrews (June 15) Civilian education officers in the Royal Air Force Educational Service—The Secretary, Air Ministry, Gwydyr House, Whitehall, S W. A junior assistant in the department of the War Department Chemist—The War Department Chemist, B 47 Royal Arsenal, Woolwich S E 18 A chief field officer of the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee, Rubber Research Institute of Malaya, 2 Idol Lane, E C 3 A lecturer in mathematics at the Gordon College, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S W.1 (marked "Mathematics") Junior research assistants under the British Cotton Research Association—The Director, British Cotton Research Association, Shirley Institute, Didsbury, Manchester.

Our Astronomical Column.

Solar Streams of Corpuscles and Magnetic Storms.—Prof S Chapman discusses the motion of streams of corpuscles from the sun in *Mon. Not. Roy Ast Soc* for March He uses Prof. A E. Milne's result that the Doppler effect will enable upward moving atoms to climb out of the absorption lines associated with them, and to be accelerated away from the sun. The acceleration diminishes as the distance increases, so that for the greater part of the journey to the earth's orbit the motion is nearly uniform. The time occupied is between one and two days, agreeing with the lag often observed after the passage of a spot over the central meridian of the sun before the arrival of the storm. It is explained that, while individual atoms are moving nearly radially, the stream as a whole is rotating with the sun and so overtakes the earth , magnetic storms therefore begin near the sunset meridian of the earth It is estimated that the breadth of a stream when crossing the earth's orbit is of the order of 50 earth-radii, in which case it would take twenty-five minutes to sweep over the earth.

The difficulty of explaining how the corpuscles can penetrate so deeply into the earth's atmosphere as to give rise to low-level auroræ is dealt with. The suggestion that these auroræ may arise from induced currents due to the corpuscles at higher levels is considered not to account for the definite forms of the auroral rays , it is thought more likely that the extrapolation used to obtain the resistance of air at extremely low density is at fault.

Fall of Meteorites into Stars.—The presence of certain wide diffuse absorption bands which are well marked in the spectra of some stars, especially those of early type, was recently attributed by Dr. H. Shapley and Miss C. H Payne to meteoric matter near the stars Later research, however, modified this view, and the glass of prisms or lenses was regarded as a more probable origin for these bands. The latter conclusion is supported by theoretical considerations published by Prof. H. N Russell in the *Astrophysical Journal*, vol. 69, p 49. It is shown that all meteorites (except abnormally large ones, more than 1 foot in diameter) will be completely volatilised before reaching the surface of the sun or a star. The gas thus produced will scatter an amount of light dependent on the ratio of radiation pressure to gravity, and in this way might account for a small fraction of the coronal luminosity The total quantity of meteoric matter falling into the sun, however, cannot exceed 60 tons per second, and the maximum effective absorption produced (when radiation pressure nearly equals gravity) is not sufficient to produce the equivalent of a single narrow Fraunhofer line It is concluded that meteoric matter cannot account for perceptible bands in the spectrum of any star which is not surrounded by extremely dense nebulosity.

The Spiral Nebulæ —New methods of study of the spiral nebulæ are being evolved with great rapidity at Mt Wilson The March issue of the *Proc U.S. Nat Acad. Sci* contains papers by Dr E P. Hubble and Milton L Humason, in which the radial velocities are studied and found to constitute a new criterion of distance. Results for some of the brighter spirals had been obtained at Flagstaff many years earlier, and it was then found that there was a general tendency to motion of recession With the 100-inch reflector it has been possible to extend the research to fainter objects, and there is now sufficient material to apply statistical methods.

It was found that those nebulæ which on other grounds were considered more remote gave larger motions of recession than those concluded to be nearer. A solution was then made of the sun's motion with respect to the system of spiral nebulæ, in which a K-term was applied (the term being derived from that used for the systematic outward movement indicated by stars of our own galaxy), this was assumed to be proportional to the distance of the object The solution gave for the sun's apex the point R A. 277°, N Decl. 36°, velocity 280 km /sec , and K 500 km /sec. per million parsecs Once this K term has been established, it can be used as a rough measure of the distance of remote nebulæ. The largest recessional motion so far detected is that of N.G C 7619, one of a small cluster of nebulæ on the border line between Pegasus and Pisces. This is receding with a speed of 3779 km /sec , which becomes 3910 when corrected for the solar motion found above The distance estimated from the speed is 25 million light-years, which is in good accord with the estimates from diameter and brightness

It is pointed out that, in de Sitter's cosmology, distant objects would show a recession increasing with remoteness , this is ascribed both to an apparent slowing down of atomic vibrations and to a general tendency of material particles to scatter ; Dr Hubble expresses the hope that observations extended to more distant objects may make it possible to evaluate the amount due to each cause

Research Items.

MODERN VIEWS ON LIFE.—A reasonably stated view of the modern conception of life, by Prof. F. G. Donnan, appears in the May number of *Scientia* under the title "The Phenomena of Life". He points out that physiological investigation has shown much of the freedom and spontaneity of life to be more apparent than real. The living being neither destroys nor creates energy; it obeys the physical law of the conservation of energy. Nor is a living thing a magical source of free energy or spontaneous action; its life and activity are ruled and controlled by the amount of free energy in its immediate environment, and it lives and acts by virtue of this, that is to say, it obeys the so-called second law of thermodynamics. Yet there is more than this in life; the unit of living matter, the cell, builds up a whole which is greater than its parts. Whether the understanding of the specific finalistic manifestations of this whole will be explained on present-day hypotheses or may demand the hypothesis of some new form of energy, the understanding will ultimately consist in something that permits of exact measurement and of precise expression in mathematical form, even though for the latter purpose a new form of mathematics may have to be invented.

EARLY CULTURE IN TEXAS, U.S.A.—A recent examination of objects found in caves in the vicinity of El Paso, of which the importance lies in the indication of future lines of research rather than in actual results, is reported by Mr. F. H. H. Roberts, jun., in No. 7 of vol. 81 of the *Smithsonian Miscellaneous Collections*. Mr. Roberts first visited the caves some years ago while investigating the pictographs of the area, including those of the far-famed Hueco Tanks, an oasis, once a rendezvous of wandering bands of Apaches and travellers across the desert. Afterwards a large number of 'curios' were unearthed in the caves by two residents of El Paso. These, together with further finds from undisturbed portions of the caves, have been examined by Mr. Roberts in a recent visit. The pictographs in the caves belong to the group in the south-west to be attributed to the Apache, though a few of the older show Pueblo influence. Three of the figures are masked heads, and stepped structures on two of these may represent a framework similar to those of which actual fragments were found in the caves. The stepped form is comparable to Pueblo forms. Birds and snakes are readily recognisable, whether naturalistic or conventionalised. Among the objects of special significance found are woven sandals of fibre, spear shafts, curved clubs, a basket armlet with a crude setting of turquoise chips, abalone shell pendants, beads, and a few fragments of pottery. The sandals are of a characteristically south-western type. The spear-shafts, which are made of the flower stem of the agave, are coloured red and decorated with balls and streamers of agave fibre. Attached to them are small rods, similar to those found elsewhere, but the significance of which is unknown. The curved clubs are comparable to those of the Basket Makers' caves of north-east Arizona and south-eastern Utah. While it is clear that there is here an admixture of early and late, these objects indicate affinities with the Basket Makers, and it is suggested that the culture of the caves is the northern fringe of the Basket Makers culture of San Juan.

CURIOUS FUNCTION OF GUMS IN A PORPOISE.—The remarkably small size of the teeth in the porpoises of the genus *Phocœnoides* is well known. Gerrit S. Miller, having examined well-preserved specimens of the Alaskan species, *P. dalli*, is of opinion that the teeth are practically functionless and that their use as organs capable of grasping food has been taken by a curious development of the gums (*Proc. U.S. Nat. Mus.*, vol. 74, 1929). The gums are modified so as to form a set of secondary gum teeth, alternating with and surrounding the true teeth, which have come to lie at the bottoms of pits between the bases of the new structures, the size and hardness of which is such that they are undoubtedly capable of functioning as efficient grasping organs. The general condition shown in this toothed cetacean is similar to that of the early stages of development of the baleen plates of the whalebone whale *Sibbaldus*, where the true teeth have disappeared, and gum teeth, compressed along the axis of the jaw, and increased in height, have formed. The resemblances are so important that the author considers that the gum and dental structures of the Alaskan porpoise represent stages of development closely parallel to those through which the corresponding parts in the toothed ancestors of the whalebone whales must have passed.

ENCYSTMENT AND CONJUGATION IN *PLEUROTRICHA*.—Reginald D. Manwell (*Biol. Bull.*, 54, 1928) describes encystment and conjugation in the hypotrichous ciliate *Pleurotricha lanceolata*, which has two macronuclei and two micronuclei. Encystment may occur at any time and appears to have no relation to periods of depression, to division, or to conjugation. Both macronuclei are extruded and only one micronucleus remains. It is uncertain whether the other micronucleus is always extruded or whether the remaining micronucleus is produced by the fusion of the two original micronuclei. From this one micronucleus the new nuclear apparatus is reconstituted, the process being complete by the time the ciliate is ready to leave the cyst. In conjugation there are three maturation divisions, an interchange of pronuclei and two, or rarely three, cleavage divisions. Of the four products of the second cleavage division one soon enlarges and gives rise to the new macronuclei of the ex-conjugant, one of the other products degenerates, and the remaining two form the new micronuclei. Reduction occurs in the second maturation division, the haploid number of chromosomes being probably twenty. "Conjugation appears to be not only an unnecessary part of the life cycle, at least as long as environmental conditions remain favourable, but is a very dangerous event, for 92 per cent of one hundred exconjugants died without further division, and only one per cent showed any indication of an accelerated fission rate," "and even in this case the daughter race died within a month."

BITTER PIT DISEASE.—Some recent investigations on the apple disease known as bitter pit, with practical information as to the chief means by which it may be avoided, are described by W. M. Carne in *Australian Journal for Scientific and Industrial Research*, vol. 1, No. 6. The disease came into prominence in Australia about 1900, and since 1911 has received the serious attentions of many scientific workers. Carne has now been able to elucidate the problem to a large extent. Picking tests with a number of varieties showed that bitter pit develops chiefly, if not entirely, in stored fruit and is thus quite distinct from cork, another disease previously known as bitter pit, but which develops on apples while on the tree. True bitter pit disease is caused by picking the fruit before it is sufficiently mature, large fruit being more susceptible than small. Although if picking is postponed too long the danger of over-ripeness during

storage is incurred, some greater delay than has been usual hitherto in the picking of apples for export will be beneficial, as not only will the liability of the fruit to bitter pit be reduced, but also a high quality in flavour and appearance will be ensured The correct date for picking can best be ascertained by means of the iodine method devised by Bigelow, Gore and Howard in 1905 The amount of starch in the apples as shown by the iodine reaction is definitely related to the amount of bitter pit disease, colour, and flavour afterwards developed after storage. The method of testing consists in dipping cut halves of freshly picked apples into an iodine solution (potassium iodide 1 gm., iodine 0·25 gm. per 100 c.c. water) for half a minute. After a short exposure to the air the distribution of the blue colour is noted If the colour is almost or entirely absent the fruit is over-mature for picking, but if scattered in small spots throughout the pulp outside the core line, the fruit can be picked with safety On the other hand, large patches of colour in the flesh indicate the necessity for allowing the apples to hang longer. With practice other apples of the desired degree of maturity can be selected by eye This procedure assumes that the fruit will be placed in cold storage within a few days from picking.

SOLANUM HYBRIDS.—An account of crosses between *Solanum utile* and pollen from the domestic potato has been given by Salaman (*Jour Genet*, vol. 20, No 3) The cross was only a success in 25 per cent of the 52 attempts, and the reciprocal cross could not be obtained at all Also, as a result of many trials, a single plant, indistinguishable from *S utile*, was obtained by pollination with *S chacoense*, and it bred true in the next generation. In the crosses between *S. utile* and the domestic potato several cultivated varieties were used as pollen parents, and with three exceptions giving the same result. In the F_2 and later generations, whole families were indistinguishable from *S utile* in morphological characters, yet certain physiological and genetic differences can be shown by back-crossing, such as the presence of sterility and the incidence of disease Some of these families, while showing the low cropping capacity of *S utile*, are nevertheless carrying recessive genes for higher cropping, the inhibitory factors of *S utile* being dominant Other families were nearly, with some plants quite, indistinguishable from the domestic type The inheritance of the differences in leaf characters and cropping are particularly described.

LEPTOCHILUS AND GENERA CONFUSED WITH IT.—Following the modern tendency in taxonomy to seek a phylogenetic arrangement for all groups of plants, E. B. Copeland (*Philippine Journal of Science*, vol. 37, No. 4, December 1928) has published a revision of the African, Indian and Oriental species of the genus *Leptochilus* Six natural groups, each given generic status, are recognised. *Leptochilus* is retained as a small genus of epiphytic ferns , the largest genus, *Campium*, consisting of terrestrial ferns with creeping rhizomes. This genus receives monographic treatment, fifty-six species—eighteen of which are newly described—being enumerated The study of the whole group is complicated owing to the involved nomenclature, and much attention is devoted to the determination of the proper generic and specific names. The paper contains a large number of text figures showing details of frond venation in the species of *Campium*, and all new species and a number of old ones are illustrated by plates.

CONIFERÆ —The identification of Conifers by means of their vegetative organs is the subject of an interesting paper which appeared recently in the *Scientific Proceedings of the Royal Dublin Society* (vol. 19, N.S. 19) The author, Mr H. M. FitzPatrick, having in mind the difficulties that beset systematists when flowers and fruit are not available, has compiled a key to the genera and species of the Coniferæ, based on the morphology of the foliage There are certain difficulties inseparable from such an attempt, not the least of these being the diversity of foliage in juvenile and adult forms of the same species The nonconformity to type of recent introductions to cultivation, particularly species of *Abies* and *Picea*, create further complications. Such a scheme of classification, to fulfil its purpose, must of necessity be an artificial one. This does not detract, however, from its value for diagnostic purposes, and in its construction Mr. FitzPatrick has achieved a considerable measure of success Leaf-shape and arrangement form the basis of the key to the genera, while its subdivisions rest on the prominence, or otherwise, of stomatal bands and midrib · the woody nature of the second-year twigs serve to distinguish the Abietineæ and Taxodium from all other Conifers. For the recognition of species special keys are introduced, following, more or less, conventional lines. In this connexion the use of variable features, pubescence for example, as specific indicators, though sanctioned by custom is open to question The ultimate definition of the species is materially assisted by a series of brief descriptions of their individual characteristics, supplemented by numerous illustrations, some of which, however, are unfortunately lacking in precision. Notes on their economic uses and distribution form a useful adjunct to descriptions of the species. The paper concludes with a short bibliography

GEOLOGICAL MAP OF MONT BLANC.—A geological map of the French part of the massif of Mont Blanc is being issued by Paul Corbin and Nicolas Oulianoff on the scale of 1/20,000. The first sheet (Servoz les Houches) appeared in 1927 The second (Chamonix) and third (Les Tines) sheets have now been issued, and each is accompanied by a descriptive pamphlet (Imprimerie-Librairie G. Jacquart Price 20 francs). A general and detailed geological description of the massif is promised in due course The maps measure nearly 14 × 10 inches, plus borders and legends, and the geological units and topographical base are clearly printed with excellent registration The Quaternary deposits are coloured in clear pale tints, the older formations being given more vigorous colours so that they stand out clearly The lithological composition of the crystalline rocks is indicated by overprintings of points and lines on the fundamental colours. In this way the major tectonic units are well brought out as well as the individual formations, sedimentary or igneous. The maps may be recommended not only to professional geologists, but also to those who may be holiday-making in the Chamonix district and wish to know something of the rocks that are there displayed.

THOLEIITES OF THE NORTH OF ENGLAND.—Continuing their work on the igneous geology of the north of England, Prof Arthur Holmes and Dr. H. F. Harwood have recently published a detailed account of the Tertiary tholeiite dykes (*Mineralogical Magazine*, March 1929, pp 1-52) Eight new chemical analyses are presented, and in addition to the Brunton, Talaidh, and Salen types already recognised by the Survey petrologists, Cleveland and Acklington types are distinguished, these referring typically to the rocks of the dykes well known under those names Although the whole suite of dykes appears to converge to a focus in Arran, it is shown that there is a regional

change of direction, as the suite traverses the Southern Uplands, which carries it by way of Great Cumbrae and the Ayrshire coast into the Mull swarm of dykes Many of the dykes carry anorthite aggregates, and Teall's original hypothesis to explain their presence is supported. A discussion of magmatic variation leads to the conclusion that differentiation by crystallisation and separation of the residual liquors was not the process responsible for the production of the different types of tholeiites. It is suggested that the variation may have been due to admixture with a Whin Sill type of magma of a quartz-alkali-felspar eutectic formed from 'sial' by long-continued contact with basaltic magma. This is a return to a long-despised conception first introduced by Bunsen to explain the igneous rocks of Iceland.

MEASUREMENT OF NILE DISCHARGE.—Over a period of more than twenty years, observations have been made with the view of the establishment of an automatic and accurate measure of the discharge of the Nile throughout the year. The last of four papers dealing with this subject is now published in Physical Department Paper No. 24 of the Ministry of Public Works, Egypt, in which Mr. D. A. F. Watt gives the final conclusions on the methods and the tables of results. It has been found that during the low stage of the Nile there is no significant difference between the results given by sluice measurements at Aswan and current meters, but that in flood time the current meters give results about five per cent too high, or even more at the top of high floods. Experiments with scale models which were described in a previous paper have been shown to be a useful means of interpolating results between the low stage and the floods when the discharge of the sluices is not known with the same certainty as at other times of the year. The important conclusion is that the discharge of the Nile at Aswan can now be measured with a high degree of accuracy by the means employed.

NORTH STAFFORDSHIRE COALFIELDS —The Department of Scientific and Industrial Research has just issued as *Paper* No. 14 of the physical and chemical survey of the national coal resources a description of the coalfields of North Staffordshire (London H M Stationery Office) This paper differs, and differs most unfortunately, from previous ones in the series, inasmuch as the special work which the Fuel Research Division of the Department of Scientific and Industrial Research is specifically supposed to perform, namely, the physical and chemical investigation of the coals of Great Britain, is entirely absent from the present paper. It contains merely a description of the North Staffordshire coalfield, such as is already obtainable elsewhere Indeed, it carries our information no further, if so far, as do the *Memoirs* of the Geological Survey. It would surely have been better to wait until the physical and chemical investigation, which the Fuel Research Division is supposed to undertake, had been completed and then to publish this information in the way that has been done in the case of the other coalfields, rather than to adopt this piecemeal method of issuing information, which, although it may at first sight lead to an appearance of great activity on the part of the Fuel Research Division, really shows that the proper work of that Division is not being pushed as it should be.

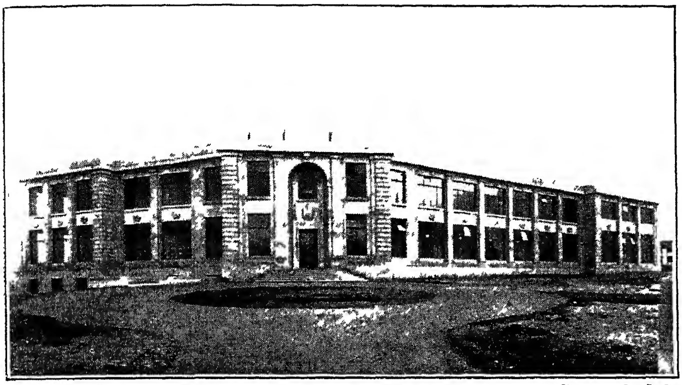
HALL EFFECT IN NICKEL-STEEL ALLOYS.—Interest attaches to the Hall effect as exhibited by the nickel-steel alloys, since the rotations of the two components of these alloys are of opposite sign, and since, moreover, such alloys present peculiarities in their thermal and electrical conductivities which, according to the electron theory, are intimately connected with the Hall effect. In the issue of the *Rendiconti* of the Naples Academy of Physical and Mathematical Sciences for May–August 1928, Dr. Umberto Salerno communicates the results of measurements of this effect made with a series of steel-nickel alloys containing different proportions of nickel. The Hall effect observed exhibits the same characteristics as that of the ferro-magnetic metals, and is influenced to some extent by the nature of the secondary electrodes employed The alloy known as invar shows a moderately high coefficient of rotation In all the alloys examined asymmetry is revealed, this being most marked with the alloy containing 22 per cent of nickel, which is the least magnetic, and almost zero with that having 49 per cent, which is highly magnetic. The contribution of the steel to the Hall effect is more pronounced than that of the nickel, 80 per cent of which is necessary to cause reversal of the sign The variation of the effect with the composition presents analogies with the corresponding variations of the specific heat, thermo-electric properties, thermal conductivity, and electrical resistance.

THE TRIPLE POINT OF WATER.—The usual specification of the zero of the centigrade scale of temperature in terms of the melting point of ice, although very convenient for most purposes, is somewhat unsatisfactory because of the difficulty of reproducing exactly the standard conditions of measurement. In particular, the effect of the air which dissolves in the water used is a little uncertain, and the German Physikalisch-Technischen Reichsanstalt has therefore had under consideration the advisability of replacing the present fixed point by the slightly higher triple point of water. A report of the experimental work that has been done in this connexion has been published by H. Moser in a recent issue (No 3) of the *Annalen der Physik*. It has been found that the temperature recorded by a platinum resistance thermometer can be held constant to one ten-thousandth of a degree when it is controlled by a bath containing pure ice, water, and water-vapour in thermal equilibrium Subsidiary measurements established that the freezing point was lowered by 0·0074° C. from this when the ice was in contact with air-free water at a pressure of one atmosphere, so that with an allowance of a further 0·0024° C for the lowering of the freezing point when the water is allowed to dissolve air to equilibrium, in accordance with the Reichsanstalt specification of the zero point, the temperature of the triple point becomes + 0·0098° C. The triple point of water is at the present time the most nearly constant fixed point of the temperature scale

ANALYSIS OF PHOSPHORIC ACID —A detailed study of the determination of phosphoric acid as magnesium pyrophosphate is described by M. Ishibashi in the *Memoirs of the College of Science, Kyoto*, vol 12, No 1. The effects of the composition of the magnesia mixture used, of the acidity of the solution, and of the presence of various salts and acids, were examined, and the conditions for maximum accuracy determined A method was developed for the quantitative precipitation of phosphoric acid as manganous ammonium phosphate, the formation of manganous acid being prevented by the addition of a small quantity of hydroxylamine hydrochloride The manganese in manganous ammonium phosphate can be exactly titrated with potassium permanganate In a third paper, a new gravimetric method is described for determining phosphoric acid as zinc pyrophosphate, and in this case the zinc may be titrated by an oxalate method

The New Department of Zoology of the University of Edinburgh.

FOR many years past the accommodation in the Department of Zoology at Edinburgh has been inadequate to meet modern needs and to cope with the number of students studying the subject. In 1923 the late Mr. Laurence Pullar, of Bridge of Earn, visited the Department and was deeply impressed with the adverse conditions he found. Mr. Pullar, who had long been sympathetically interested in zoology, more particularly in those branches of it that occupied the attention of his friend the late Sir John Murray, made a donation of £20,000 towards the erection of new laboratories. His much-appreciated gift remained anonymous until shortly before his death in 1926. In the same year the Trustees of the Carnegie Trust for the Universities of Scotland, in their allocation of grants for the quinquennium 1925–30, set aside a sum of £18,000.



Photo] [Francis Caird Inglis

FIG. 1.—The new Department of Zoology of the University of Edinburgh.

Prof. Augustus Trowbridge, of Princeton University, then director for Europe of the International Education Board, paid an unannounced visit to the Department in 1926 and inquired into its needs and financial position. As a result of this, and with his sympathetic co-operation, Prof. J. H. Ashworth was enabled to draw up a statement of the requirements. The Board saw its way to give £74,000 for the completion of a building, for equipment, endowment, and addition to staff and technicians.

Prof. Ashworth drew up sketch plans which were placed in the hands of Sir Robert Lorimer and Mr. J. Matthew, and work was commenced in June 1927. The building was formally opened by H.R.H. Prince George on May 15 last in the presence of the Vice-Chancellor, a large number of representatives of the national and civic authorities, and of zoologists from other universities. In his speech, Prince George referred to the traditions of the Department, the chair of which was founded in 1770, and to the importance of zoology and its many applications to the welfare not only of Great Britain, but of the whole Empire. The need for trained zoologists, particularly overseas, at the present time is great. The building is the second of a new group known by permission as the King's Buildings, and Prince George expressed his pleasure at learning that through the munificence of various donors, private and corporate, other buildings were soon to be erected on the same site, forming part of a scheme for the expansion of the University. He congratulated the architects upon their success in combining pleasing effect with utility.

After the opening, Prince George was invested with the honorary degree of Doctor of Laws, made a tour of inspection, and attended a luncheon in the Old University buildings. The University O.T.C. mounted a guard of honour.

The new building (Fig. 1) is of sandstone from the Blaxter quarry, and consists of a central part with a larger wing facing north and a smaller one facing north-east; its total length is 287 feet. It is two-storied for the greater part, but the fall of the ground allows of a well-lit 'basement' under the east wing. Between the large windows in the upper and lower stories are a number of panels with oval medallions about 4 ft. 6 in. long bearing representations of a series of animals. They are arranged in sequence and chosen to represent the main zoogeographical regions. They are the work of Miss Phyllis Bone, who also furnished for the lintels above the first floor windows smaller round medallions of three animals well known to ancient naturalists, the scarab, the crab, and the octopus.

Throughout the whole building the most emphasised feature is the provision of the maximum amount of light. The museum, which is for teaching purposes,

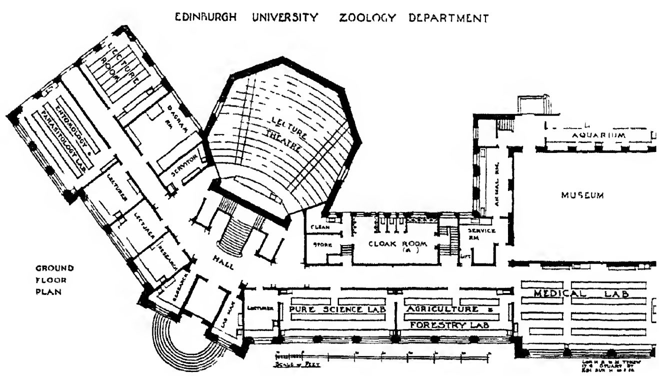


FIG. 2.—Plan of ground floor.

is 55 feet long by 40 feet wide, with a 10-foot gallery along one of its long sides, under which is a well-equipped aquarium. The main museum is lit by a cupola and the gallery by an oblique roof light, and in both is a new type of glass devised by Sir Herbert Jackson in conjunction with Messrs. Chance. It is designed to exclude the ultra-violet and strong actinic rays, and at the same time provide a maximum transmission and diffusion of direct sunlight. The library is furnished with enamelled steel shelving, gallery, stair, and stack room, and has an initial accommodation of about 8000 volumes, which should

form an adequate reference collection. The large lecture theatre, occupying most of the central part, is of octagonal form, has a specially constructed diagram screen, and provides 318 separate seats, the two smaller theatres for advanced and post-graduate students each accommodate about 50. The laboratories and research rooms on the two wings are laid out as a series of units 15 feet wide by 16 feet deep, and the inclusion of several units gives laboratories of the sizes required for all the different classes The Department has, besides the laboratories for the staff, technicians' rooms, workshop, etc, eight separate research rooms each for one worker, and a larger room which would accommodate two to four workers

The total cost of the building has been £80,000, and it is felt that with its modern equipment and design it provides adequate facilities for teaching purposes and for the various lines of research that are now being carried on or are likely to be undertaken for some years to come. Two main objects have been kept in the forefront of all the designing; first, fitness for purpose, and secondly, the utilisation of standard units which permit of the maximum amount of interchange and therefore flexibility.

Forest Insurance.

IN *Special Bulletin* No. 179 (September 1928), issued by the Experiment Station of the Michigan State College of Agriculture, Mr. Paul A Herbert discusses "Forest Insurance and its application in Michigan" The greater part of the author's thesis is devoted to the great forest problem in the United States of fires and fire protection, and the consequent higher rates demanded for insurance on forest property exposed, as is the case in America, to this peril Mr Herbert cites the more or less successful efforts at forest insurance attempted in European countries, which had their origin in France and Germany in 1880, Norway in 1912, Finland since the Armistice, in Belgium, Holland, Denmark in the late years of last century, and finally in Sweden since 1919

In treating of ordinary insurance as against insurance against forest fires, the author points out as one of the difficulties that annual returns are not obtainable in the younger stages of a forest, and therefore the private owners of land do not consider that forestry can compete with other productive enterprises. He rightly concludes that the reluctance of landowners to take up forestry as a business undertaking is based mainly on general questions of the risks, the rate of tree growth, and rough calculations as to future costs and prices. It may be admitted that investment in the forestry business will not usually bring in the early returns obtainable from other enterprises, whilst the risks are in some respects greater

The methods often suggested in order to assist the private landowner to make forestry a paying business are more equitable taxation, government assistance, and better protective methods. These, coupled with an anticipated future increase in the price of timber and other forest produce, would, it is held, make private forestry a paying business. These factors would tend to decrease the cost of production or decrease the risk to which the invested capital is exposed

On the subject of taxation of woods, the usual remedy suggested is deferred taxation on lands occupied by woods The chief advantage of this method would lie not in reduced costs, but in reduced risks, and would allow the timber grower to estimate his future taxation in this respect If any accident happened to the crop or impaired its value the taxes would automatically be reduced Government assistance, the author considers, should be mainly confined to paying for research work which is beyond the power of the private owner to undertake, whilst the third remedy, protection, involves decreasing the risks and therefore improving the property from an insurance point of view.

The keynote of the author's discussion is the reduction of risk by effective protection, thus facilitating insurance of the property Such insurance, by eliminating further risks and losses, will place forestry on a business basis. "The capitalist", says Mr. Herbert, "will find the profits obtainable are large enough to be attractive in view of the reduction of uncertainties. The investor will consider the insured forest as sufficient security to warrant lending funds to the business at the usual rate of interest" The whole crux of the business in many countries, both in the past and the present, is bound up with the methods in force in land taxation, which often do not sufficiently distinguish between land from which an annual return is obtainable and that from which the returns are deferred for long periods, as is the case in forestry.

University and Educational Intelligence.

CAMBRIDGE —Dr D. Stockdale, fellow of King's College, has been appointed University demonstrator in the Department of Chemistry.

LONDON —The result of the Convocation elections to the new Senate of the University of London—a general election following the new Statutes—was announced at the meeting of Convocation on May 14. In the Science Faculty there were eleven candidates for five seats, the successful candidates being Dr. C W Kimmins with 1018 votes, Prof. F. G Donnan, 934, Sir Philip Magnus, 889, Dr R H. Pickard, 847, and Mr G. D Dunkerley, 835. The unsuccessful candidates were Prof Winifred Cullis, 806; Dr. G T Morgan, 783, Sir Llewellyn Smith, 544; Mr. W. A W Dagger, 426; Mr. T. Ll. Humberstone, 354; and Mr. A. E. Evans, 307. In the Arts Faculty the old members were re-elected, with the addition of Prof T. P Nunn. In Engineering, Mr. Roger T. Smith, and in Economics, Dr. W H. Coates were elected, both being new members of the Senate The representatives of faculties include the following — Faculty of Medicine Lord Dawson of Penn, Dr. H L. Eason, and Sir Cuthbert S. Wallace, Faculty of Science Prof. A. J. Allmand, Prof. L. N. G. Filon, Dame Helen Gwynne-Vaughan, and Prof. Frank Horton, Faculty of Engineering Prof. S. M. Dixon and Prof E H Lamb, Faculty of Economics (including Commerce and Industry) and Political Science: Prof T. E. G. Gregory.

MANCHESTER.—Applications are invited for the Edmund Mills Harwood memorial scholarship, value £50 per annum for three years, at the Manchester Municipal College of Technology. Forms of application and all information are obtainable from the Registrar of the College. The latest date for the return of completed forms is June 15.

ST. ANDREWS.—The University Court has appointed Dr. Frederick Walker, at present assistant in geology, to be a lecturer in geology as from the beginning of the next academical year

LIKE so many other professions, that of surveying grows more important, complex, and difficult. Old rules of thumb and hastily formed opinions can no longer be applied If, among the surveyor's essential

qualifications, mathematics and a wide knowledge of central and local government are added to those divisions and subdivisions of his practical work, it becomes clear that the old method of apprenticeship is quite inadequate Such points were emphasised by Mr. B W. Adkins in a paper on the education of the young surveyor which he read, on April 8, before a general meeting of the Surveyors' Institution Mr. Adkins showed how the system of examinations and other facilities of the Institution have met these changes and made it possible for the profession to be supplied with qualified practitioners Tracing some present weaknesses, he said that if a boy leaves school at sixteen or seventeen and decides to be a surveyor, he finds that he cannot take the intermediate examination for several years During the interim, although serving articles, he frequently loses the habit of study, since he is free from school discipline and has no immediate spur towards theoretical work To meet this difficulty and to ensure continuity of study, the Institution has decided to adopt recommendations which will enable the future surveyor to take the more elementary part of the intermediate examination before the age of nineteen Mr. Adkins considered, too, that the recent introduction of a compulsory preliminary examination will remedy other weaknesses such as bad spelling, indifferent English, and lack of accuracy and method. Mr. Adkins' belief in the work already done by examinations and their future possibility was very definitely expressed. "There have been numerous attempts to discredit the examination system. . . . I am confident that, if properly devised, a system of examination is the best method of inducing young men to acquire such knowledge as is necessary for their progress."

The Committee of Award for the Commonwealth Fund Fellowships has made appointments to twenty-four fellowships tenable by British graduates in American universities for the two years beginning September next. These include: Mr. Eric Ashby (London) to Chicago, in botany; Mr Geoffrey Crowther (Cambridge) to Yale, in economics; Dr. H J. Emeleus (London) to Princeton, in chemistry; Miss G. H Faulkner (Edinburgh) to Chicago, in zoology, Mr. W L. S Fleming (Cambridge) to Yale, in geology; Mr. V S. Forbes (Cambridge) to California, in geology, Mr. J. N. Goodier (Cambridge) to Michigan, in structural engineering; Mr. A. Harvey (Durham) to California, in physics; Mr. R. C. Hinton (London) to Cornell, in economics; Dr. W G. Humphrey (Oxford) to Harvard, in chemistry; Mr. W. R. Humphries (Aberdeen) to Columbia, in education; Mr J. W. Maccoll (Glasgow) to California Institute of Technology, in engineering (aerodynamic); Mr. H L Puxley (Oxford) to Yale, in economics, Mr D. M. Robinson (London) to the Massachusetts Institute of Technology, in electrical engineering; Dr. A. F. Skinner (St Andrews) to Columbia, in education; Mr. E T. C. Spooner (Cambridge) to Harvard, in medicine; Mr. A. J Watters (St. Andrews) to Wisconsin, in organic chemistry, Mr. J. H C. Whitehead (Oxford) to Princeton, in mathematics; and Mr. R van de R. Woolley (Cambridge) to the California Institute of Technology, in astronomy. Fellowships tenable by candidates from the British Dominions include Mr. H. Barak (New Zealand and Oxford) to Princeton, in physical chemistry; Mr. H. V Warren (British Columbia and Oxford) to the California Institute of Technology, in geology The following have been appointed to fellowships tenable by candidates holding appointments in government service · Mr. Eric J. Bradshaw (Dublin) of the Geological Survey of India, Mr. R. M. Campbell (New Zealand) of the New Zealand Civil Service, Mr A H Crane (Adelaide) of the Queensland Forestry Service.

Calendar of Patent Records.

May 26, 1733—The patent granted to John Kay of Bury on May 26, 1733, covered the invention of the fly-shuttle, perhaps the most important improvement ever made in the loom It revolutionised the weaving industry and rendered the power loom possible But it left Kay a poor man The last we hear of him is in 1766, when he appeared before a Committee of the Society of Arts, and he must have died soon after, probably in France, where he had tried to obtain the recognition that he failed to get in his own country.

May 26, 1798.—The principle of the hydraulic ram was first used for raising water by John Whitehurst of Derby, who applied it to a domestic water-supply in such a manner that every time the tap was turned on and off in the kitchen, a column of water was forced into a tank in the upper part of the house. Whitehurst sent a description of his apparatus to the Royal Society in 1770, but its value as a water-raising machine was not recognised until an improved self-acting type was invented by Joseph Michel Montgolfier and patented by him in France on May 26, 1798. An English patent was granted in the preceding year to Matthew Boulton acting as Montgolfier's agent

May 29, 1624.—The first legislative enactment for regulating the granting of industrial monopolies was the Statute of Monopolies (21 Jac I c 3) passed by the English parliament on May 29, 1624. The Statute was not, as has often been assumed, the foundation of the English patent law; it merely gave parliamentary sanction to principles which had long been accepted at common law. Its purpose was to prevent the Crown from granting oppressive monopolies, but in the famous Section 6 it exempted from the general prohibition the granting of patents for the encouragement of new inventions. This section is still in force.

May 29, 1849.—David Smith of New York was granted an English patent on May 29, 1849, for an improved shot-tower for making small shot, in which the fused metal falls through an ascending current of air, a process which enabled a much shorter tower to be used.

May 31, 1836.—There were many inventions before this date for the use of the screw propeller in steam navigation, but credit for its practical introduction is mainly due to Francis Pettit Smith, whose English patent is dated May 31, 1836. Pettit Smith's invention, first tried on a small 10-ton 6-h.p. vessel which was successfully run on the Thames and afterwards at sea, was, at the request of the Admiralty, fitted to the *Archimedes* of 237 tons and 80 h p, which attained a speed of 10 miles per hour. Smith realised little from his invention, but he was given a civil list pension of £200 a year and in 1871 received the honour of knighthood. For the last thirteen years of his life he was the curator of the then Patent Office Museum.

June 1, 1869.—Thomas Alva Edison's first patent was granted in the United States on June 1, 1869, for an electrical apparatus designed "to record and register in an instant and with great accuracy the votes of legislative bodies," each member having a switch in front of him by moving which he could have his name impressed electrically under either the affirmative or negative votes. Edison's output of inventions has been enormous, the United States patent records showing that for upwards of forty years patents have been granted to him at the rate of about twenty-five a year, the greatest number in any one year being seventy-five in 1882

Societies and Academies.

LONDON.

Geological Society, April 24.—Robert Murray-Hughes: The geology of part of North-Western Rhodesia, with petrographical notes by A. A. Fitch. The area lies approximately between lat. 14° and 17° S. and long. 24° and 30° E., and falls into three natural divisions, from west to east. The first is the flat, somewhat swampy country overlaid by the Karroo and Kalahari rocks; the second is the old peneplain-surface forming the plateau of Northern Rhodesia and underlaid by the Transvaal and Pretoria rocks, and those of the Swaziland System; and the third, a deeply dissected country overlaid mostly by the Swaziland rocks and drained by the Zambezi and Luangwa rivers. The rocks are described and correlated with the Transvaal and Pretoria Systems of the south. The covering of sand in the west, together with certain 'ancient laterites', is correlated with the Kalahari System. The principal structural features are: (1) North-east and south-west foliation caused by the intrusion of the Older Granites; (2) north-west and south-east fracturing caused by the intrusion of the Hook Granite; (3) graben faulting, which forms a part of the Great Rift Valley; (4) folding of the Karroo Beds.

Royal Anthropological Institute, April 30.—J. H. Driberg: Gala colonists of the sixteenth century. Analyses the varying incidence of Hamitic influence on the different Bantu tribes of the Lake region. Two immigrant cultures, the first of Gala origin *circa* 1600 to 1680, the second represented by the Bahinda dynasty and possibly referable to Lake Chad. Linguistic and cultural evidence for the Gala hypothesis. That the focus of this Hamitic culture lies to the west of Lake Victoria indicates that the immigrant route was via Mongalla and Wadelai. Traces of Gala influence are to be found among the Lerya, where it is linguistic, and among the Bari, where it is cultural, the present serf class representing the descendants of Gala invaders overthrown by a Bari rising. Nilotic and Nilo-Hamitic convulsions due to Gala intervention during the fifteenth and sixteenth centuries, as revealed by a comparison of Nilotic and Bantu genealogies. The southward expansion of the Gala towards the Tana valley, the inception of a militant policy against the Abyssinians, and their colonisation of the cattle-breeding countries round Lake Victoria, should all be correlated.

Society of Public Analysts, May 1.—R. S. Morrell and S. Marks: The determination of organic peroxides. A modification of Fahrion's method of determining the peroxide oxygen in oxidised linseed oil by measuring the iodine liberated from potassium iodide in the presence of sulphuric acid has been devised.—**J. W. Croxford**: Differential halogen absorption of oils and fats. Toms's bromine vapour method of determining the halogen absorption of oils gives rapidly the true iodine value of oils and fatty acids which require very many hours for complete absorption of the Wijs' reagent. Fatty acids and oils of the oleic acid series with the double bond adjoining the carboxyl group may thus be recognised. Iso-oleic acids formed in the hydrogenation of oils, and the petroselinic acid of parsley seed oil, give similar results by the two methods, and have thus the double bond at a distance from the carboxyl group.—**W. R. Schoeller and C. Jahn**: A new method for the separation of small quantities of tantalum and niobium from titanium. The solution containing the oxalates is treated with sodium salicylate, which converts the titania into a stable crystalloidal sodium titanylsalicylate. The earth acids are then precipitated with calcium chloride, and finally precipitated with tannin.—**H. R. Ambler**: The analysis of small samples of gas. Apparatus for the analysis of small samples of about 1 c.c. of gas, in which rubber connexions are abolished.

DUBLIN.

Royal Dublin Society, Mar. 26.—J. Reilly, P. J. Drumm, and C. Boyle: The production of essential oils from Irish-grown plants (Part 5). Oil of dill.—**M. Grimes**: A study of lactose-fermenting yeasts found in milk, cream, and butter. The yeasts examined consisted of two types: Type *A*, similar to, or identical with *Torula lactosa*, Harrison, isolated from Canadian cheese; type *B*, similar to, or identical with *Torula cremoris*, Hammer, isolated from yeasty cream.—**J. H. J. Poole and A. J. Clarke**: The effect of strong electric and magnetic fields on the rectilinear propagation of gamma rays. Sir J. J. Thomson has suggested that, since electrons show some of the characteristics of very high frequency wave trains, very hard gamma rays may possess some of the properties of charged particles, and he conducted some trials on a possible bending of a gamma ray beam in a dielectric exposed to a large transverse electric field. His results, on the whole, were negative. The present paper describes further trials, not only with electric, but also with strong magnetic fields. No effect in either case could be detected.

EDINBURGH.

Royal Society, May 6.—G. N. Hunter: Colour sensitivity. In *Proc. Opt. Convention*, 1926, Dr. Houston described a new method of testing for colour blindness. The apparatus was purposely made insensitive by keeping the two colour patches under comparison 8 mm. apart. In the present research, these patches have been brought into juxtaposition, resulting in a great increase in colour sensitivity, estimated at 1000 per cent.—**E. B. Ludlam and R. B. Mooney**: The influence of air and moisture on the 'Budde effect' in bromine. The absence of expansion of pure dry bromine when exposed to light is explicable by calculating the rate at which the energy received can be taken up by the walls of the vessel; a film of moisture may prevent the re-combination of bromine atoms on the surface and thereby retain the energy in the body of the gas. Air present in the gas may facilitate transfer of energy and cause expansion. There is no evidence of re-radiation of energy.—**A. C. Stephen**: Studies on the Scottish marine fauna. The fauna of the sandy and muddy areas of the tidal zone. The density per unit area has been investigated. Parts of the Firth of Clyde (more than 3000 per square metre) and St. Andrews Bay, West Sands, are areas of exceptional abundance. The various species are not uniformly distributed over any beach, but either occur, or have their maximum density at, some particular level. On sandy grounds *Tellina tenuis* and *Nephthys cæca* predominate, on the muddy grounds *Cardium edule* and *Macoma baltica*.—**G. Redington**: Effect of diurnal periodicity on plant growth. By growing plants entirely in electric light, it is shown that a daily dark period is not essential, but with practically all the very diverse species grown, better plants were ultimately produced in 16 hours' light per day than in continuous light. Generally, poor growth was made in a light exposure of 8 hours' daily. The effect of the several physiological processes concerned upon the conditions obtaining at the apical meristem is considered in relation to cell formation and cell elongation.—**Margery Knight**: Studies in the Ectocarpaceæ (2). *Ectocarpus siliculosus*. Plants

collected from the Mediterranean coasts show a simple type of life history in which the plant body is haploid and reproduction is effected by the union of gametes produced in plurilocular sporangia The dominant soma of the British plants is, however, diploid and the zoids from plurilocular sporangia on these plants are already diploid and germinate immediately into new plants; sexual reproduction is achieved by zoids from unilocular sporangia. Alternation of generations and sex differentiation are also discussed.—**Mary H Latham**: Jurassic and Kainozoic corals from Somaliland. This collection of fossil corals from British Somaliland was made by Mr R A Farquharson, Government Geologist, during his survey of the country in 1923–24 It includes Jurassic, Eocene, Oligocene, and one Pleistocene specimen. Most of the specimens are Eocene and were collected mainly in eastern Somaliland; but some specimens from Deberaweina in western Somaliland have been identified as Eocene That district has not hitherto yielded Eocene corals There are three new species of *Astrocœnia*, all of which have large corallites and greatly resemble *Stephanocœnia*, and a new species of *Cyathocœnia* There is also a new genus, *Tubicora*, belonging to the *Goniocoridæ* The Oligocene corals include new species of *Stylophora*, *Circophyllia*, *Favia*, *Orbicella*, *Columnastræa*, and *Porites*. The older faunas have Mediterranean affinities —**Sydney Goldstein** The asymptotic expansion of the characteristic numbers of the Mathieu equation.

PARIS.

Academy of Sciences, April 15 —The president announced the death of M Gayon, *Correspondant* for the Section of Rural Economy —**P. Séjourné**. The railway from Casablanca to Marrakech. The branch line for phosphates. This line, 245 km long, was commenced in 1916, the discovery of rich phosphate deposits at Kouribgha led to an alteration of the plans and the construction of a branch line 83 km long (150 km. from Casablanca). Details of the phosphate deposits are given. these deposits are remarkable both as regards high percentage of calcium phosphate and quantity available —**Emm de Margerie**: Second report on the publication of the "œuvres géologiques de Marcel Bertrand".—**V. Romanovski**: Some new classes of orthogonal polynomials.—**M. de Franchis**: A recent theorem concerning quadrics —**Hadamard**: Remarks on the preceding communication —**Rolf Nevanlinna**: Remarks on the lemma of Schwarz —**Lucien Féraud**: The Pfaffian systems of M Birkhoff. —**G. A Mokrzycki**. The maximum utilisation of commercial aeroplanes. —**Antonio Cabreira**: The theory of a terrestrial metric planosphere —**Benjamin Jekhowsky**. The identification of the minor planets and the correction of their orbits from a single observation —**J. E Verschaffelt** The equation of Van der Waals and thermodynamics Reply to criticisms by V. Karpen.—**Quevron** The increase in the sensibility of electrical measuring apparatus with pivots. The permanent magnet in the instrument is replaced by an electromagnet. The power required is 150 watts, giving a magnetic field of 4500 gauss. With this instrument it is possible to measure by direct reading 10^{-8} ampere or 10^{-5} volt Possible applications are discussed.—**J. Cabannes**: The secondary radiations in light diffused by Iceland spar —**H. Jedrzejowski**. The groupings of radioactive atoms —**L. Wertenstein**: The β-recoil.—**André Chrétien**: The ternary system: water, sodium sulphate, sodium nitrate.—**H. Parent**: The existence in Provence of a shore line at 6 metres, of recent Quaternary age.—**Henryk Arctowski and Edward Stenz**: The origin of the dusts which fell in Poland between April 26 and 29, 1928. Proofs that the dusts which fell in Roumania and Poland on the above days originated in central Ukraine —**Joseph Devaux**. The actinometric study of the penetration of the solar energy flux at the interior of some Pyrenees glaciers When the solar radiations penetrate the mass of glaciers, with the ice at 0° C., the absorbed energy produces a partial fusion of the ice, especially at the surface, which becomes porous This porous condition reduces the transparency of the ice to the rays, resulting in less penetration and less melting. This process the author terms the radiothermic defence of glaciers —**Yossifovitch Mladen**: The mechanism of the separation of the perithecium in the Erysiphaceæ and the rôle of the fulcra —**A Maige**: The rôle of the cytoplasm in amylogenesis —**Lucien Daniel** The resistance to cold of the descendants of *Artemisia Absinthium* grafted on *Chrysanthemum frutescens*. New varieties of absinthe plants, produced from seeds resulting from grafting Absinthium on Chrysanthemum, have proved very resistant to cold. At the temperature of Rennes last winter (−21° C.), numerous species regarded as acclimatised to the winter have been severely affected, but the Absinthe arising from the grafts have survived —**H. Lagatu and L Maume** The leaf diagnosis and its degree of security —**J Vellard** The properties of the cutaneous secretions of some tree frogs (*Hyla*) from the neighbourhood of Rio de Janeiro. The toxicity of these secretions is as frequent in the group of Hylidæ as in other species The toxic characters vary greatly with the species —**R. Fosse and A Brunel**: The ferment producing allantoic acid by the hydrolysis of allantoin. Its presence in the animal kingdom A ferment capable of giving allantoic acid from allantoin has been demonstrated in the frog and in several fishes —**Georges Lakhovsky** The sterilisation of water and of liquids by circuits in metal in direct contact with the liquid.

Official Publications Received.

BRITISH

Stonyhurst College Observatory Results of Geophysical and Solar Observations, 1928, with Report and Notes of the Director, Rev E D. O'Connor Pp xxii+50 (Blackburn)

Journal of the Chemical Society containing Papers communicated to the Society April Pp iii+589-852+viii (London)

Imperial Institute Annual Report, 1928, by the Director, Lieut-Gen. Sir William Furse, to the Board of Governors (Meeting, 19th March 1929) Pp vi+36 (London)

Report of the Oversea Settlement Committee for the Year ended 31st December 1928 (Cmd 3308) Pp 43 (London H M. Stationery Office) 9*d* net

Reports of the Progress of Applied Chemistry Issued by the Society of Chemical Industry Vol 23, 1928 Pp 760 (London)

Proceedings of the Royal Society Series A, Vol 124, No A793, May 2 Pp 242 (London Harrison and Sons, Ltd) 8*s*

Transactions of the Royal Society of Edinburgh Vol 56, Part 1, No 11 The Anatomy of a Fœtal African Elephant, *Elephas africanus* (Loxodonta africana) Part 3 The Contents of the Thorax and Abdomen and the Skeleton By Dr Nellie B Eales Pp. 203-246+6 plates (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd) 7*s* 6*d*

FOREIGN

Japanese Journal of Botany Transactions and Abstracts Vol 4, No 3 Pp ix+219-316+55-79 (Tokyo National Research Council of Japan)

Department of Commerce Bureau of Standards Research Paper No 55 An Analysis of the Arc and Spark Spectra of Yttrium (Yt I and Yt II) By William F Meggers and Henry Norris Russell Pp 733-769. 10 cents Research Paper No 56 The Precise Measurement of X-ray Dosage By Lauriston S Taylor Pp 771-785 10 cents (Washington, D C Government Printing Office)

Review of Legal Education in the United States and Canada for the Year 1928. By Alfred Z Reed Pp iii+51 (New York City The Carnegie Foundation for the Advancement of Teaching) Free

Department of Commerce Bureau of Standards United States Government Master Specification, No 23c Lamps, Electric, Incandescent, Large, Tungsten Filament Supersedes F S B No 23b and Bureau of Standards Circular No 13, 11th edition Revision promulgated by the Federal Specifications Board on March 25, 1929 Pp ii+12 (Washington, D C Government Printing Office) 5 cents

CATALOGUE.

Eastman Organic Chemicals List No 20, May Pp 90 (Rochester, N Y Eastman Kodak Co)

Diary of Societies.

FRIDAY, May 24

Society of Medical Officers of Health (Fever Hospital Medical Service Group), at 3.—Dr W. M. MacFarlane and others: Discussion on The Uses of Scarlet Fever Antitoxin.

Linnean Society of London (Anniversary Meeting), at 5.—Presidential Address and Presentation of Linnean Gold Medal to Prof. H. de Vries.

Physical Society (at Imperial College of Science), at 5.—Dr. Ezer Griffiths: A Hygrometer for Use in Timber Seasoning Kilns.—Dr. J. H. Vincent: Experiments on Magnetostrictive Oscillators at Radio Frequencies.—Demonstration of an Apparatus for Measuring the Thermal Expansion of Glass, by Prof. W. E. S. Turner.—Demonstration of the Flutter Model Aeroplane Wings, by R. A. Fraser and W. Duncan.

Royal Society of Medicine (Disease in Children Section) (Annual General Meeting), at 5.—Dr. F. J. Poynton: Some Phases in English Pediatrics as viewed by a General Physician.

Royal Society of Medicine (Epidemiology Section) (Annual General Meeting), at 8.—Dr. A. Joe: Puerperal Fever.

Royal Institution of Great Britain, at 9.—F. J. Rennell Rodd: The Tuareg Tribes of Central Sahara.

Institute of Chemistry (Edinburgh and East of Scotland and Glasgow Sections) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland and Glasgow Sections) (at Glasgow).—Prof. G. G. Henderson: Recent Research in the Terpene Series.

Institution of Water Engineers (at Birmingham).

SATURDAY, May 25

Physiological Society (in Physiology Department, University, Edinburgh), at 10 A.M. and at 2.—H. E. Magee, Prof. J. J. R. Macleod, and D. W. Auchinachie: Diffusion in Surviving Gut of Different Sugars.—J. McCallum and H. E. Magee: Effects of Diet and of Adrenalectomy on Movements of Surviving Intestine.—H. E. C. Wilson: A Note on Specific Dynamic Action.—C. M. Burns: (*a*) Influence of Ingestion of Mineral Acids on the Mineral Constituents of Tissues; (*b*) Influence of Parathormone on the Composition of Bone.—D. Burns: Action of Salts of Guanidine on the Vasomotor System.—H. Dryerre: (*a*) Effect of Administration of Calcium Chloride on the *p*H of Urine; (*b*) Calcium Metabolism in Relation to Lactation.—May Cameron: Differences of Structure between the White and Red Muscles of the Rabbit.—B. P. Wiesner: On the Mechanism of Controlling Changes in Ovarian Endocrine Functions.—A. W. Greenwood: On the Effects of Implantation of Cock's Testis into the Hen.—E. M. Robertson: On the Zondek-Ascheim Pregnancy Test.—L. Miskaja: The Effects of Implantation of Mouse Placenta on the Reproducing System of the Immature Female.—W. P. Kennedy: The Ganglion *cervicis uteri* and the Œstrus Hormone.—G. H. Ettinger: An Investigation into the Conditions of the Pulmonary Circulation of the Guinea-pig.—A. Fraser and Prof. J. J. R. Macleod: Glycogen and Lactic Acid in Mammalian Muscle after Death.—G. P. McCullagh, G. D. F. McFadden, and Prof. T. H. Milroy: Cutaneous Temperatures after Lumbar Sympathectomy.—Demonstrations.—A. C. White and C. P. Stewart: On the Estimation of Small Amounts of Soap.—A. C. White and A. J. Clark: Apparatus for the Estimation of the Oxygen Consumption of the Frog's Heart.—Y. Bogue: Electro-cardiograms from the Hen's Egg.—Prof. P. T. Herring: Secretion by the Cells of the Convoluted Tubules of the Kidney of the Skate.—J. D. S. Cameron: Secretion of Urea by the Cells of the Convoluted Tubules of the Kidney of the Dogfish.—Sir E. Sharpey Schafer: The Relation Between the Liver Cells and the Blood.—Prof. F. A. E. Crew: The Miniature Egg of the Domestic Fowl.—G. H. Ettinger: (*a*) Pitfalls Liable to be met with in Perfusion Experiments; (*b*) Peculiarities in Structure of the Pulmonary Arterioles of the Guinea-Pig, Ox, and Cat.—W. O. Kermack and W. Leiper: A New Method for Demonstrating and Measuring the Activity of Pepsin.—W. W. Taylor: Method of Determining Free and Bound Water.—A. R. Smellie: An Improved Type of Pump for Artificial Respiration.—J. Davidson: Selective Action of Senecefoline on the Liver Cell.

North of England Institute of Mining and Mechanical Engineers (Associates' and Students' Section) (Annual General Meeting) (Newcastle-upon-Tyne), at 3.—H. S. Jackson: Mine Costs.

Institute of Chemistry (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland and Glasgow Sections) (at Glasgow).

MONDAY, May 27

Victoria Institute (at Central Buildings, Westminster), at 4.30.—Sir W. M. Flinders Petrie: The Materialisation of Old Testament History.

Surveyors' Institution (Annual General Meeting), at 5.

Royal Institute of British Architects, at 8.—H. P. Adams: English Hospital Planning.

Royal Society of Medicine (Odontology Section) (Annual General Meeting) (at Royal College of Surgeons), at 8.

Royal Geographical Society (at Æolian Hall), at 8.30.—L. J. Robbins: A Journey in Central Siam.

TUESDAY, May 28

Royal Dublin Society (at Ball's Bridge, Dublin), at 4.15.—Prof. J. Joly: A New Form of Needle for Radium Therapy.—Dr. W. R. G. Atkins and Dr. H. H. Poole: Photo-electric Measurements of Illumination in Relation to Plant Distribution. Part II.

Royal Society of Medicine (Medicine Section), at 5.—Annual General Meeting.

Royal Society of Medicine, at 5.30.—General Meeting.

Zoological Society of London, at 5.30.—Secretary: Report on the Additions to the Society's Menagerie during the month of April 1929.—W. N. Blair: Observations on the British Shrew *Crocidura cassiteridum*.—Miss E. M. Brown: Notes on the Larval Stages of the Tompot Blenny, *Blennius gattorugine*.—Dr. C. Christy: On the African Buffaloes.—G. C. Robson: On the Rare Abyssal Octopod *Melanoteuthis*: a Contribution to the Phylogeny of the Octopoda.

Royal Photographic Society of Great Britain (Kinematograph Group), at 7.—Capt. G. I. Finch: A Crossing of Mont Blanc.

Royal Anthropological Institute, at 8.30.—Mrs. M. Hasluck: Turkish Games.

West Kent Scientific Society (at Wesleyan Hall, Blackheath), at 8.30.

WEDNESDAY, May 29

Geological Society of London, at 5.30.—Dr. K. S. Sandford: The Pliocene and Pleistocene Deposits of Wadi Qena and of the Nile Valley between Luxor and Assiut (Qau).—Miss E. W. Gardner: Geological Researches in the Fayûm (Egypt), being a report on work done with the assistance of the Gloyne Outdoor Geological Research Fund.

Eugenics Society (at Royal Society), at 8.30.—E. B. Ford: Recent Work on the Physiology of Genetics and its Bearing on Human Problems.

THURSDAY, May 30

Royal Society, at 4.30.—Prof. O. W. Richardson and P. M. Davidson: The Energy Functions of the H_2 Molecules.—Dr. E. K. Rideal, C. P. Snow, F. I. G. Rawlins, and A. M. Taylor: Infra-Red Investigations of Molecular Structure. Part I.—C. P. Snow, F. I. G. Rawlins, and Dr. E. K. Rideal: Infra-Red Investigations of Molecular Structure. Part II.—Dr. A. Muller: The Connexion between the Zig-Zag Structure of the Hydrocarbon Chain and the Alternations in the Properties of Odd and Even Numbered Chain Compounds.—*Papers to be read in title only*:—Prof. O. W. Richardson and F. S. Robertson: The Emission of Soft X-Rays by Different Elements at Higher Voltages.—G. I. Finch and D. L. Hodge: Gaseous Combustion in Electric Discharge. Part III.—G. I. Finch and J. C. Stimson: The Electrical Condition of Hot Surfaces during the Adsorption of Gases. Part III.—J. M. Robertson: An X-Ray Investigation of the Structure of Naphthalene and Anthracene.—D. L. Chapman and W. K. Hall: A Study of the Catalysis by Silver of the Union of Hydrogen and Oxygen.—K. Majumdar: The Arc Spectrum of Chlorine.—A. E. Gillam and R. A. Morton: The Absorption Spectra of Halogens and Inter-Halogen Compounds in Solution in Carbon Tetrachloride.—K. R. Rao: The Arc Spectrum of Germanium.—R. H. Fowler and A. H. Wilson: A Detailed Study of the 'Radioactive Decay' of, and the Penetration of α Particles into a Simplified One-Dimensional Nucleus.—U. Nakaya: On the Emission of Soft X-Rays by Different Elements, with Reference to the Effect of Adsorbed Gas.—R. A. Frazer and A. J. Duncan: (*a*) On the Criteria for the Stability of Small Motions; (*b*) On the Numerical Solution of Equations with Complex Roots.—N. F. Mott: The Scattering of Fast Electrons by Atomic Nuclei.—L. J. Freeman: Further Investigations of the Spectrum of Ionised Nitrogen (N II).—G. C. McVitie: On Einstein's Unified Field Theory.—L. P. Davies: The Soft X-Ray Emission from Various Elements after Oxidation.

Institute of Pathology and Research (St. Mary's Hospital), at 5.—Prof. F. W. Twort: The Position of Ultramicroscopic Viruses in the Living World.

Chemical Society (at Institution of Mechanical Engineers), at 5.30.—Prof. W. H. Perkin: The Early History of the Synthesis of Closed Carbon Chains (Pedler Lecture).

Royal Society of Medicine (Electro-Therapeutics Section) (at Langham Hotel), at 7.—Annual General Meeting.

C.B.C. Society for Constructive Birth Control and Racial Progress (at Essex Hall, Strand), at 8.—Dr. M. Thomson: Sterilisation of the Unfit.

FRIDAY, May 31.

Royal Institution of Great Britain, at 9.—Prof. E. N. da C. Andrade: The Air Pump: Past and Present.

PUBLIC LECTURES.

FRIDAY, May 24.

Birkbeck College, at 5.30.—Prof. S. de Geer: Sweden and the North of Europe. (Succeeding Lectures on May 28 and 30.)

MONDAY, May 27

Royal School of Mines, at 5.15.—Dr. C. J. Smithells: Minor Constituents in Industrial Metals and Alloys (Armourers' and Brasiers' Company Lectures—continued on June 3 and 10).

Sir John Cass Technical Institute, at 7.—Dr. M. A. Matthews: Low Temperature Tar.

TUESDAY, May 28

University College, at 5.30.—Prof. A. Brachet: Experimental Embryology. (Succeeding Lectures on May 29 and 31.)

WEDNESDAY, May 29

University College, at 5.30.—Prof. E. D. Wiersma: The Psychology of Dementia. (Succeeding Lecture on May 30.)

Northampton Polytechnic Institute, at 7.—G. Patchin: Engineering Alloys (Armourers' and Brasiers' Company Lectures—continued on June 5 and 12).

THURSDAY, May 30.

London School of Economics, at 5.—Prof. A. Aall: The Psychology of the Individual and of the Mass. (Succeeding Lecture on May 31.)

FRIDAY, May 31

Chelsea Physic Garden, at 5.—H. V. Taylor: Supplies from the Vegetable Kingdom and the Public Health (Chadwick Lecture).

SATURDAY, JUNE 1, 1929.

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University Staffs and Salaries.

WHAT reforms in the present organisation of the universities of Great Britain, other than Oxford and Cambridge, may be deemed necessary for the continuance of their professed functions? So long ago as September 1924, in the course of an article on university staffs and university finance, we suggested that drastic changes were inevitable and probably imminent, however unprepared for them the universities might be. The publication of the Returns of the University Grants Committee for last year [1] encourages us to resume this urgent topic. The Commissioners' survey "does not suggest that there has been any material change in the general financial position of the University Institutions concerned". By a process of logic which must be somewhat unconventional, the Commissioners infer from this statement that "Steady if unsensational progress continues to be made". Nothing stands still: no disaster has attended the affairs of the universities, so they must be progressing.

The Commissioners have, of course, a very delicate and difficult task before them. They represent a degree of official enlightenment rare in affairs of State. The old order is still very much the old order in the universities. The State's contribution last year represented very little short of three-quarters of the salaries paid. The policy of the Grants Committee is well known. It is to make an end, if possible, of the prevailing gross under-payment of staffs. The salary bill is by far the largest presented to the universities—more than half the total expenditure, which for the first time exceeds £5,000,000. The Grants Committee allocates £1,523,772. The total parliamentary grants reach £1,841,005. The first of these figures represents actually an excess over the million and a half promised. The commitment was formerly only a million, and in agreeing to increase it the Committee expressed the opinion that the greater part of the extra amount should be devoted to raising salaries. This has not been done. Some of the universities claim that it has been done, but the figures contradict them. The sum of £90,000, under the heading 'Salaries and Superannuation', by which university expenditure for last year exceeded that in the previous year, covers both increased salaries and the cost of new posts. Since new posts number eighty-four, the sum devoted to correcting total inadequacy of remuneration could not have

[1] University Grants Committee: Returns from Universities and University Colleges in receipt of Treasury Grant, 1927–28. Pp. 24. (London: H.M. Stationery Office, 1929.) 3s. net.

been enough for the needs of a single one of the larger institutions

We are where we were, and the optimism which leads the Commissioners to interpret some movements as necessarily progressive appears scarcely to be justified Had there been any real deference to the wishes of the Committee, it is evident that it would be revealed in an alteration in the proportion which salaries bear to total expenditure. An approximation which takes us back to 1922–23 can be gained from the whole maintenance table in the Return which excludes Oxford and Cambridge . 65·3 per cent in 1922–23, 65 3 per cent in 1926–27, and 65 9 per cent last year Another table provides the actual figures for the past two years for salaries and superannuation alone . 50 03 per cent in 1926–27 and 50 4 per cent last year

From under-payment of university staffs a whole train of evils proceeds. While a sufficient number of eminent representatives of an earlier social and intellectual environment remain to give an appearance of dignity to academic pursuits, there is and can be no assurance for the future so long as the standard of remuneration is one far exceeded by the earnings of many shop assistants, let alone professional men and those engaged in the vague if profitable service of the community 'business'; so long as every 'interest', professional, commercial, or industrial, can attract the livelier and more competent from concern with fundamentals to concern with applications , so long as modern educational demands, however legitimate, are permitted to prevent the performance of the avowed intentions of founders and patrons

In every human activity much depends upon the actual human beings engaged in its maintenance , but it is doubtful whether this dependence upon the quality and devotion and performance of individuals is so absolute anywhere else as in the universities Their fellow-citizens, even those of them who have personal acquaintance with a university, still retain a sort of inertia of reverence for it and for its sister institutions, as the fount and origin of knowledge The creative spirit in the arts and humane letters may and does rise to greater altitudes elsewhere ; the same spirit in discovery, the fundamental natural law-giving, whence all other discovery and invention proceed, can in modern conditions thrive nowhere else. Here alone is the living knowledge, undiminished by secondary understanding and uncontaminated by the ageing falsity of books Shelley's question " as to how far a thirst for a happier condition of moral and political society survives among the enlightened and refined, the tempests which have shaken the age in which we live " is answered in our own time, if the recompense of these excellencies is only penury and social excommunication

To advance knowledge and to extend science strictly interpreted—interpreted, that is to say, as W K Clifford interpreted scientific *thought* as distinct from the slightly humbler use of other people's scientific thoughts—is a work for genius Those who possess it are a minority of academic workers, as they are a minority in the community as a whole. They will always be attracted to university work irrespective of the conditions But that does not absolve the community from its responsibility If the flame of intellectual conquest burns so consumingly in such men that they will sacrifice every human and humane obligation for its satisfaction, the social conscience is surely guilty if, while it is aware of the sublime benefits which are bestowed, it neglects to intervene for the protection of needy dependents If it seems, then, an act of folly or of genius to accept the present terms of most of the universities in Britain, must we conclude that the majority who do accept these terms cannot be of the stuff which gives body to the intellectual resources of the country ? The time must come when that will be true Those who possess what is after all a marketable talent can be retained in the service of the universities only at a just price.

The earnest local patriotism and idealism which brought the newer universities into being did not in the first place correctly envisage the human and financial obligations involved, and are now inadequate to rectify the evils which have ensued. State aid is directed particularly to reform ; but reform is refused Why ? The scarcity of relevant facts upon which an answer to this question might be based is one of the reasons which render the appointment of a commission with full powers so urgently necessary There is no common recognition of the claims of disinterested inquiry. The politician in all his forms, parochial to imperial, promises wider and wider educational advantages ; scholarships increase ; but the real philanthropist is the academic worker The rich donor supplies only the bricks and mortar , it is the teacher and research worker who supply the human material at their own cost For true education or for self-advancement the community must be supplied with a superabundance of facilities, and the academic worker must pay the cost. Organisation would of course soon bring the administrative mind to its senses ; but organisation is prevented by cross-currents of sectional interest, by fear, by pride, and

not least by ignorance. One faculty does not know what another does. In consequence, the presentation of the just claims of one against another is sometimes embittered and the sources of defeat may be disguised and concealed.

Some incredulity may be occasioned by the statement that the universities have recently made an official representation for the purpose, not of bettering the condition of staffs, but of securing the withdrawal of existing forces which might be expected to achieve that end. Resistance to trade union action is intelligible, and these facts are not put forward without some sympathy with that view. Nevertheless, they indicate the danger underlying sectional and particularly professional representation of the university opinion. One of the newer universities recently defended itself against a public charge by stating that the universities were powerless in the matter, having merely to obey the General Medical Council. Sixty-six per cent of the Council are elected by the universities and colleges. Powerlessness is, therefore, not apparent. Too often faculties act for universities, and in medicine the faculties are virtually the practising profession.

At some time between the summer of 1926 and the end of 1927 the 'governing bodies of the universities' asked for the withdrawal of a modest scale of remuneration for non-professorial university workers which the British Medical Association had proposed to enforce. In consequence, a conference was held on Feb. 10, 1928, between representatives of the Association and representatives of the medical schools, mostly deans. These representatives created the impression that non-professorial medical workers had many privileges and were at all events merely using the universities as stepping-stones to lucrative practice. A *non possumus* resolution was passed. Last summer not this resolution but another exempting temporary workers, and temporary workers only, from the operation of the scale was passed by the Representative Body of the Association. An amendment by the Hendon division, which insisted that in no case could anatomists and physiologists be regarded as temporary workers, was accepted rather dubiously by the chairman, making this meaning clearer. Very few weeks had passed, however, before the *British Medical Journal* contained advertisements for anatomists and physiologists at salaries £200 below the scale. Inquiry elicited the information that the appointments were 'temporary', although one man (at Sheffield) was to be equipped in every imaginable non-clinical direction and able to take the place of the professor in his absence. The medical profession fears—quite unnecessarily—that the present wasteful and absurd system of artificially favoured seniority will be jeopardised if young and brilliant men are made independent of patronage. Other faculties fear preferential treatment which, admittedly, would be disastrous to the university idea. But the example given is but one of the pernicious results of professional patronage and is worthy of the consideration of members of all faculties.

Naturally, the Returns refer to the "comparative neglect of the Biological Sciences other than Medicine". May we suggest that one of the matters considered by the Joint Committee which has been appointed "to examine the practical steps which should be taken to secure the development of the teaching of Biology by co-operation between the Universities and the secondary schools" would very appropriately be the desirability of remunerating the teachers at least as well as the taught? At one university, where a scale has been sanctioned and re-sanctioned, it is impossible under the scale for any non-professorial teacher to attain to a salary of £500 a year in less than thirteen years. In some cases the men concerned could not be employed elsewhere at a salary below £600 for the first of these thirteen years.

Sufficient has been said to show that inquiry, and inquiry alone, can now disentangle the multitude of interests involved. Four years ago we said: "It is absurd to pretend that under such conditions their normal duties can be efficiently conducted, and an inquiry into the whole question of payment and the evils that are arising from continued under-payment is undoubtedly urgent before the rot has time to inflict permanent harm on university teaching". The rot advances. Time which should properly be spent in research or recreation is used to supplement meagre and insufficient incomes. Financial pressure and the vastly wider facilities for research under Government supervision drain from university service many men of superior ability. The universities afford fewer and fewer opportunities of instruction at first-hand by men actually engaged in the advancement of their subjects, and the loss to students denied personal contact with original and creative minds will speedily destroy the whole significance of university training. Already there are fundamental departments of science which have been neglected in England for a quarter of a century. "No material change" does not mean "steady progress". It means that decline is inevitable unless there is a substantial improvement of existing conditions.

Ancient Knossos.

The Palace of Minos: a Comparative Account of the Successive Stages of the Early Cretan Civilisation as illustrated by the Discoveries at Knossos By Sir Arthur Evans. Vol. 2, Part 1: *Fresh Lights on Origins and External Relations; the Restoration in Town and Palace after Seismic Catastrophe towards close of M.M. III, and the Beginnings of the New Era.* Pp xxii + 390 + 10 plates. Vol. 2, Part 2: *Town-houses in Knossos of the New Era and restored West Palace Section, with its State Approach.* Pp xiv + 391-844 + 18 plates. (London: Macmillan and Co., Ltd., 1928.) 147*s*. net.

IT is now nearly thirty years since the political liberation of Crete from Turkish rule made excavation possible on the site of ancient Knossos, and the knoll then called Kephála had been recognised, some ten years earlier still, as concealing a pre-Hellenic building, one or two chambers of which—part of the famous 'palace magazines'—were indeed partially opened by a Cretan gentleman who had been appropriately christened Minos. Almost without intermission since 1900—except in the War years—and under the single direction of Sir Arthur Evans, the dissection, and latterly also the reconstruction, of a 'Palace of Minos' has gone on, with ever-widening scope outside the palace-area, and ever-growing wealth of experience suggesting re-examination of structures and substructures already recognised and cleared.

In the first years of tentative discovery, a bulletin of each season's proceedings, in the *Annual* of the British School of Archæology at Athens, was publication enough Later came monographs, in *Archæologia* and elsewhere, on special enterprises, such as the opening of the 'Royal Tombs' hard by; and the first volume of "Scripta Minoa" on the earlier and mainly pictographic phases of the Minoan script. The later 'linear' scripts still remain for the most part unpublished, though most of the documents were found quite in the earliest seasons' work. Then in 1921 appeared the first volume of "The Palace of Minos at Knossos", bringing together in masterly perspective the main results so far as they concern the history of the site, and the chief phases of its civilisation down to the point at which it begins to be proper to speak of a 'palace' there at all. Next came another interval punctuated with published studies of special problems, the paper on the "Ring of Nestor" and other remarkable pieces of engraved gold work from the Greek mainland, and the Huxley Lecture on early connexions between Crete, Libya, and the Nile Valley; and now we have the second volume of "The Palace of Minos at Knossos", ampler even than the first, but happily bound up in two sections, which make it a much less formidable implement of study and reference.

This new volume does not merely take up the story where it was left by its predecessor. As the author frankly says, "the excavation of Knossos itself may almost be said to have renewed its youth", it has been "a perpetual source of wonderment" to the excavator, supplementing, and almost invariably substantiating earlier observations and conjectures. So multiple and diverse are these discoveries, that merely to marshal them in intelligible order is a notable achievement. Habitual users will note with satisfaction that the pagination of the two parts of volume 2 is continuous, and also that the numbering of the sections is continuous with that of volume 1, a very great aid to concise reference.

The sections contained in the two parts of volume 2 run from § 33 to § 67 inclusive, and deal mainly, though not by any means exclusively, with the latter part of the Middle Minoan and the beginning of the Late Minoan phases; that is to say, from about 1750 to 1500 B.C. Each deals at the same time with a separate topic or problem, and advances the general argument and historical reconstruction. But since the appearance of volume 1 in 1921 a good deal has been done to clear up obscurities and supplement what was known then about the earlier periods, and §§ 33-34 serve also as a retrospect both of these years of work of the early Minoan and adolescent Middle Minoan phases; and of the general position of Crete and its culture in the ancient world.

Beneath the central court of the later palaces, the discovery of late neolithic houses gives occasion (§ 33) to a revised estimate of the connexion between the earliest occupants of this part of Crete and the people of Asia Minor, which is represented as more directly concerned than the Greek peninsula, though it is still over-early to decide this point. Western Crete has scarcely been touched yet, and very little has been done in mainland districts south of Argolis Moreover, even in Asia Minor the rugged south-western districts are still almost unknown, and comparisons between Crete and Cappadocia are necessarily provisional. Geographically, however, access has always been comparatively easy from southern Asia Minor to Crete, thanks to the set of the current and the

regularity of the *imbat* winds, far more important for coastal traffic than the seasonal *meltem*

For this reason it may well be that eventual intercourse with the Nile Valley (§ 34) was for Crete rather an extension of this coastal traffic than the result of transmarine exploration Probably what gave this intercourse its vogue and vitalising force at both ends was the discovery that at the far extremity of the " Great Bight "—to modernise an Egyptian phrase about the " great circuit of the lands "—it was possible to spread sail before a *meltem*, as the fruit-boats of Cos do now, and regain the Nile mouths in a few days It is important, however, to distinguish (as is here done) Nilotic from other Libyan intercourse, and in early days it is the latter that appears to have been primary, as a number of distinct elements show, types of boats, hair-dressing, costume, stone-worked vessels, cupola-tombs, and so forth In early dynastic times, when the Delta became Egyptised, Egyptian influence succeeds to Libyan in this Cretan ' staple ' or depot.

How did this oversea traffic come ? By a ' transit road ' traced (§ 35) from minute ports nestling under the Asterusian ridge south of the Messarà plain, over the well-guarded pass east of Mount Ida, and round the west shoulder of Mount Juktas, entering Knossos eventually by the Minoan viaduct (§ 36) with its caravanserai, bath-house, and ' partridge-fresco ' (§ 37), and the ' stepped portico ' (§ 38) rising into the south end of the ' palace '-site. Special problems of technique and procedure confronted the excavator here, for the sintered soil was as hard as the masonry of the viaduct, and the spirits of the workmen had to be maintained by a fresh plan of remuneration The technique of Minoan commerce, too, demands special examination of the means of transport, ox, ass, eventually horse and mule, wheeled vehicles for goods, courier-borne palanquins for notables, as a fragmentary fresco shows

What went by this age-long road, and whither ? The answer (§ 39) comes from the signs of Minoan influence far away to the west and north, in Malta, the Iberian peninsula, even in Britain The connexion between early Maltese monuments and Minoan arts and practices has been disputed, more than once, and there is still a question of degree, but it becomes difficult to dissociate the decorative motives, and if these be borrowed from Minoan, the relative date of the Maltese culture seems to be determined, and therewith much in the western Mediterranean. In the other direction, Cretan arts of design, already known to have affected Egyptian decorative work in the Eighteenth Dynasty, are now (§§ 40, 41) detected in a similar relation to the Middle Empire; a conspicuous instance is the recent find at Harageh, dated to the time of Sneferu II, about 1890 B C.

Corresponding with the ports of the south coast, the harbour-town of Knossos itself has been discovered and partially explored (§ 42), but lying in the outskirts of modern Candia, and moreover in the zone devastated by both Venetians and Turks during the great seventeenth-century siege, it contributes only suggestive details In addition to her other functions, the ' Great Goddess ' looked after seafarers, anticipating both Isis Pelagia in classical times, and the medieval Madonna Is it, however, certain that all these representations of potent or protective women are attributable to one and the same goddess, or rather (as Nilsson suggests in his " Minoan-Mycenæan Religion ") to several, perhaps many, departmental deities ? Through this—and probably also through other ports on the north coast, Nirou-Khani, for example (§ 44)—Crete was apparently brought into separate intercourse with Syrian centres, and their cults and manners (§ 43) illustrated by a fashion of bull-headed libation-vessels, and by occasional finds of cylinder-seals Deeper-seated are those aspects of Cretan religious belief which are illustrated by the insignia of a priest-king from the French excavations at Mallia, and by the curious find at Nirou-Khani, which Sir Arthur Evans describes as a " propagandist depot ", of portable altars and double-axes

After these retrospective and supplementary studies, resulting from the last few years' operations, the main thread of the story is taken up again in § 45 at the moment of the disastrous earthquake which wrecked Knossos during the Third Middle-Minoan period, and profoundly affected its subsequent fortunes. The direct damage was serious enough, especially in the south-east quarter of the ' palace ', where the site had been greatly enlarged over substructures which now collapsed and overwhelmed the houses which occupied the slopes below. But the moral effects were more lasting (§ 46). Propitiatory ritual before rebuildings was natural enough, and is illustrated graphically, but the new custom seems to have come to stay, in the form of a ' pillar-cult ', and the worship of an ' earth-shaker ' incarnate in bull-form, side by side with the god of the ' double-axe ' (§ 47) and at times merged in him The general ' distress of nations ' after the disaster is shown directly by the marked reduction of the occupied area at

Knossos, and no less vividly by those emigrations of which the settlements on the Greek mainland about this time are the first fruits. In quite a different direction, widespread ruin meant abundant opportunity for the builder and decorator (§§ 48-54). As we have seen in our own time, at such a period of 'reparations' the arts progress rapidly (§ 48); experiments are tried on every hand; foreign models have their vogue, and the copies of the first imitators pass into the common repertory of their successors. Was it such a change of taste, or another earthquake (such as Crete seems to suffer about twice in a century) that brought about the 'scrapping' of the lovely painted stucco in the 'House of the Frescoes'—the "cultured home of a small burgher"—outside the Palace proper (§ 52)? And why were the 'scrapped' fragments so carefully stowed away in the house itself, to the delight of posterity? It is a further discovery (§ 53), that the decoration of house-walls and other large-scale work is the source and inspiration of the minuscule art and abridged designs of the pottery and perishable gear of everyday life.

In these artistically favourable circumstances arose from the ruins of the 'older palace' the 'broad Knossos' of Homeric folk-memory, in the golden age of Minoan Crete (§ 56). Fearless, because secure abroad, and therefore unfortified and unconfined, the growing population spent growing wealth on commodious suburbs, beyond the Kairatos river, for example (§ 55); and other Cretan towns flourished accordingly. An eloquent signal is the rapid disuse of timber for house-building; as in our own Renaissance, deforestation had begun.

The remainder of the volume (§§ 57-67) surveys the reconstructed 'palace' in systematic order, beginning with the 'state approach' from the north-west (§ 57), the 'theatral area' for receptions and pageantry, the 'west court', and the 'treasure house' (§ 59), with its splendid hoard of bronze vessels and household furniture (§ 60); and the 'west porch' (§ 61) and 'south propylæum' (§ 62) with their processional frescoes, to which the well-known 'cup-bearer' belongs. Here is the occasion for discussing the no less famous 'Keftiu tributaries' from the walls of Egyptian tombs, and the tell-tale offerings which they carry (§ 63). So we pass on into the 'ceremonial corridor' (§§ 64-65), which runs north and south into the main mass of 'palace' structures, and so to the 'central court' (§ 66), where it has even been possible to recover the main architectural features of the façade; and to detect links between the religious ritual of the 'sanctuary quarter' of the 'palace' and the worship of Apollo at Delphi, a striking counterpart to the Greek legend of the Cretan origin of the Delphic priesthood, and to the worship of the 'Delphinian' Apollo at Knossos, and elsewhere in Crete, in Hellenic times.

For the remainder of the Late Minoan buildings, and especially for the magnificent 'north gate' and its decorations, we have still to wait for volume 3, and still more have we to wait for an index; but it is only right to acknowledge the utility, meanwhile, of the marginal catch-titles, and the analysis prefixed to each section; and to admire the skill with which so vast and at first sight heterogeneous a collection of data has been arranged so that each topic occurs, like an episode of saga, in a context which is memorable in itself, and makes subsequent reference easy.

That is in itself a feat of no mean art, as everyone will admit who has had to write reports of excavation. So much that is found is always at first sight negligible or inexplicable, but for this very reason must be all the more scrupulously recorded and conserved. So much, at the same time, that seems essential to any reconstruction at all, is *not* found, but has to be 'restored' with more or less confidence—and 'scrapped' sometimes, like any other hypothesis, as knowledge grows. In Ægean archæology, knowledge has grown amazingly, though very unevenly, while Knossos itself has been under examination; even in Crete, American, French, Italian, Greek, and other British excavators have contributed much, especially to fill certain gaps in the Knossian series; for example, about the time of the great earthquake, and also in respect of those early periods, the deposits from which were levelled away from the top of the Kephála hill when 'palace' construction began. With these exceptions, Knossos has remained, as it began, central and typical; and the record of its recovery is a classic of archæological literature.

Scarcely less unusual than his presentation of results has been the excavator's treatment of the 'palace' as an exhibit and a place of study. Nothing is more dreary or confusing than the litter of displaced fragments which disfigures most sites after excavation, except perhaps the knowledge that this or that important detail is 'now in London' or elsewhere. Now, at Knossos, nothing has been removed, except to the Candia Museum for safe custody; nothing, on the other hand, of which the place could be ascertained, has been

allowed to remain out of that place, if the understanding of the whole could be facilitated thereby This has meant unusual expenditure and labour in reconstruction, the provision of facsimiles of fallen frescoes and other perishable detail, the unpicking and rebuilding of crushed or unstable walls Examples are apparent in the illustrations to this volume, and some of them are startling in their audacity, when they are judged by other people's practice But no one, it must be remembered, has ever had a site of this quality to study or to dissect under such favourable conditions, with complete continuity of direction, and concentration of responsibility and initiative Remote as Knossos is, and must remain, it is a place of pilgrimage for students of archæology—the art and technique of recovering the past—as well of antiquity, and it is only when the attempt is made to reconstruct the Kephála of thirty years ago from the recreated Knossos of to-day that the full meaning of this record is appreciated

J L M

Incidental Natural History.

(1) *Further Correspondence of John Ray* Edited by Dr Robert W T Gunther (The Ray Society Volume for the Year 1928, No 114) Pp xxiv + 332 + 4 plates (London. Dulau and Co, Ltd, 1928) 12*s* 6*d* net

(2) *Physiologus: a Metrical Bestiary of Twelve Chapters by Bishop Theobald* Printed in Cologne, 1492 The Author is believed to have been Abbot of Monte Cassino A D 1022–1035, and a Description of the Abbey is appended with Illustrations Translated by Lieut-Col Alan Wood Rendell Pp xxvii + 34 + 100 + 15 plates (London: John and Edward Bumpus, Ltd, 1928) 10*s* 6*d* net

(1) THE Ray Society has already issued two works, the "Memorials" (1846) and the "Correspondence of John Ray" (1848), which may be said to have achieved their object of keeping alive the memory of "the greatest all-round naturalist of his time" The present addition, made possible by financial assistance from a revered and venerable successor of John Ray, Prof W. C M'Intosh, "is the outcome of a re-discovery in the Bodleian Library of a number of letters of John Ray which have not only never been printed *in extenso*, but which form a necessary supplement to the volume of *The Correspondence*". To these have been added materials obtained from the *Philosophical Transactions* and archives of the Royal Society, and from the British Museum The work has been edited by Dr R W. T Gunther, to whose activities the history of science owes many useful contributions Although the short lives of Ray by Dale and Petiver are reprinted, Dr Gunther's volume is not, and does not pretend to be, a final biography of Ray in the form of a coherent narrative, and its interest lies rather in a series of disconnected incidents and opinions which nevertheless will be most valuable to the future biographer of Ray when he appears Ray is generally believed to have been born in 1628 and to have died in 1705 The dates inscribed on his tomb are 1628 and 1706 Both are now stated to be erroneous, the latter being corrected to 1705, and as regards the former, we have the evidence of the parish register that he was born in 1627

To give some idea of the contents of the volume, a few samples may be selected The letter on the anatomy of the "Porpess", dated 1671, is printed in full, and illustrates fairly Ray's powers and limitations as an anatomist and a systematist It does not compare very favourably with the fuller account of the anatomy of the same animal published in 1680 by Edward Tyson Ray, however, clearly recognises and demonstrates that the anatomy of the porpoise must be interpreted in terms of the quadruped, which after all is the main point Nevertheless, in his "Historia Piscium", published in 1686, he still retains the Cetacea among the fishes. He describes also the compound stomach of the porpoise, the lobulate kidneys and the mammal-like genitalia Although he mentions the elongated larynx, he failed to recognise, as did all the older comparative anatomists, the existence of, and the reason for, an intranarial epiglottis The brain is briefly and accurately described, but he missed the external auditory meatus, which, though very small, had been seen by Belon and Rondeletius before him, and by Daniel Major and Tyson immediately after

An interesting account is given of the publication of Ray's work on fishes, the expenses of which plunged the Royal Society into a state of bankruptcy Samuel Pepys, at that time president of the Society, took a deep interest in this work, which was dedicated to him. In spite of the fact that the cost of a number of the 187 plates had been guaranteed, there was a deficit of £360, and an attempt to dispose of 400 copies abroad at 25*s*. a copy having apparently failed, the Society was unable to pay the stipends of its officers in cash, but offered them instead copies of this unremunerative

work It was sold at the time for 20s, and it may be noted that its present market value is about £3, 10s

Ray was naturally familiar with the horn of the narwhal, but had interpreted it as a median structure, and had not been aware, until informed by Edward Lhwyd, that the horn may be paired He, however, missed the significance of this variation, but regarded the paired condition as normal, "so that we are again to seek for a Monoceros, which we had thought we had found among fishes". It is somewhat surprising to find that Ray knew the work of Leonhard Baldner, the Strasbourg fisherman, who published the first observations on the metamorphosis of the lamprey in 1666. Ray, however, "not understanding high Dutch", was unable to make much use of Baldner's work, whose name, by the way, he mis-spells Baltner

Some of the letters show that the mild and uncomplaining Ray could on occasion scarify his contemporaries, and in this respect he appears in a new light Walter Charleton comes in for severe treatment He "did not understand animals", his "Onomasticon Zoicon" was cribbed and inaccurate, and he is surprised that "such a book should find so much acceptance as to come to a second impression" Dr. Woodward is arrogant, presumptuous, and highly conceited, his notions are ridiculous, but, adds Ray in mitigation, the interpretation of fossils is so difficult that "a man hazards his reputation that is positive and confident on either side".

We must express our indebtedness to Dr Gunther for this important collection of Raviana, and he has increased the obligation by preparing an index which covers not only his own volume, but also the previous collection of letters published in 1848

(2) This work includes an illustrated description of the famous Benedictine monastery of Monte Cassino, about 90 miles from Rome—a description which has some topical interest, since the Abbey is at the moment celebrating the fourteen-hundredth anniversary of its foundation This description will therefore be useful to those who are visiting Rome, and may induce them to include in their tour an excursion to Monte Cassino We have not visited the monastery personally, but we would ask whether there is not something radically wrong with the date ascribed to the arcade figured in Plate 14

Col. Rendell has performed a very useful service to learning by publishing a photographic reproduction of this important and fascinating incunable. We wish that considerations of expense did not preclude the practice being generally followed. Such a reproduction is practically as good for the purposes of study as the original, and we can only regret that the Bishop's inspiration did not run to the whole of the forty or so chapters of the "Physiologus" Col Rendell, however, has done more than reproduce his copy of this rare book—he has provided us with a translation of it, a serious task, of the merit of which there may be differences of opinion, but of which none will question the usefulness The condensed and at times erratic form of the original makes a literal translation, which Col Rendell has attempted, particularly difficult, and he has not always succeeded in the double object of abiding by the text and at the same time producing a version in intelligible English He confines himself largely to the 1492 edition of the Bestiary, and does not concern himself with the extensive literature of the "Physiologus", nor with discussions of such questions as a comparison of "Physiologus" with the "Nuzhatu-l-Qulûb", recently attempted by Col. Stephenson

There are two appendices—one a partial translation of an Italian article on an unpublished moralised Bestiary of the twelfth century from the archives of the Chapter of Fano, and the other a comparison of the Fano version with the Cologne printed text of 1492, and another Latin version known as the Migne.

Popular Astronomy.

(1) *The Sun, the Stars, and the Universe.* By Dr. W M Smart Pp. xii + 291 + 20 plates (London, New York and Toronto · Longmans, Green and Co, Ltd., 1928) 12s 6d. net

(2) *Astrophysics · the Characteristics and Evolution of the Stars.* By Dr W M Smart (Benn's Sixpenny Library, No 36) Pp 80. (London: Ernest Benn, Ltd., 1928.) 6d.

RESEARCH in astronomy in these days is so fascinating and exacting a pursuit that one could understand, if not excuse, the neglect of one of the primary duties of investigators—to inform the general public of the progress of their science It is essential that this should be done by astronomers themselves, for, in the bewildering speed of modern progress, they alone have the least chance of seeing the position steadily and seeing it whole. Fortunately, they have not neglected their duty. During the last few years there has been a remark-

able output of popular astronomical literature of a trustworthy type, and there is now no difficulty, as once there was, in directing an inquirer, of whatever intellectual capacity, to a satisfactory account of the astronomical knowledge so far obtained Dr Smart is the latest addition to the band of authoritative expositors, and the two books before us make it clear that he is well fitted for the task which he has undertaken

(1) The larger volume—"The Sun, the Stars, and the Universe"—"has been designed to present, in descriptive language and with an historical background, an account of modern astronomical discoveries and of present-day views concerning the characteristics, constitution, and organisation of the heavenly bodies". This is a fair statement of its achievements, and indicates better than the title what aspects of general astronomy have been selected for consideration The order of treatment is not unconventional. The first four chapters are introductory in character, dealing in general terms with the solar system, the celestial sphere, some aspects of early astronomical history, and astronomical instruments—the chapter describing the last named being inadequately entitled "The Telescope". Then follow two chapters on the sun, and one on the moon, planets, and comets, after which the various departments of stellar astronomy are discussed in eight chapters. Three of these are devoted to the movements of the stars—an unusually large proportion, for which, however, there is much to be said. It scarcely exaggerates the importance which stellar movements are likely to assume in the future progress of astronomy. Two further chapters—on star clusters and nebulæ, and the universe, respectively—bring the book to a conclusion. The illustrations are numerous and well-chosen, and are excellently reproduced

The treatment throughout is as non-technical as possible, and entirely non-mathematical. it does not, however, on that account suffer in accuracy or precision. In one respect, perhaps, the ideal of precision has been followed too unswervingly Dr. Smart states in the preface that when the chapter on stellar evolution was written there were three different evolutionary theories in the field, and it seemed advisable "in a popular book to devote the available space to a somewhat detailed account of one theory rather than to attempt to produce a condensed description of all three". It is at least questionable if the existence of a multiplicity of expert opinions on any matter is a valid reason for describing only one in a non-polemical work—and particularly for giving "a somewhat detailed account" of that one It is doubtful, too, if the nebulous state of general opinion on stellar evolution can be said to contain anything so definite as "three theories" An appropriate vagueness in the tone (not the logical meaning) of the account of this subject, condensing here and there into the chief features of the various bodies of thought, would possibly have given a truer account of the actual state of affairs than a clear-cut description of a particular view It is only fair, however, to add that Dr Smart makes no attempt to hide or disguise the difficulties and uncertainties of the subject

(2) The little volume on "Astrophysics", which is a member of Messrs Benn's admirable Sixpenny Library, necessarily deals with much the same material as the later portion of the larger work. It is carefully planned and is very successful in covering a great deal of ground without giving the impression of undue haste. It is illustrated by several diagrams and is altogether appropriate to the character of the series of books to which it belongs.

Dr Smart writes clearly and interestingly. His sentences are rarely, if ever, ambiguous, and his accuracy is as great as can be expected of one man who undertakes to survey so vast a field. The inevitable slips and misprints are few and unimportant He has, however, an unfortunate tendency of aiming at stimulating the imagination by the use of hyperbole. This is sometimes merely ineffective, as in the frequent repetition of such words as 'stupendous' and 'amazing', and sometimes definitely misleading, as in the remark that the radial velocities of spiral nebulæ are 'incomparably' greater than the velocities of galactic objects (Incidentally, it may be questioned whether it is not the smallness rather than the greatness of the velocities of spirals that is most striking With a possibility of relative velocities up to the speed of light, is it not surprising and probably significant that independent universes should amble past one another at no more than about 1000 miles per second ?) This characteristic is expressive of the failure—far too general among writers of popular scientific books—to distinguish between the educated, non-scientific man and the child. Dr Smart is too able an expositor to be allowed to persist in this attitude without protest, and we trust that in his future writings he will give the same careful attention to the mental characteristics of his prospective readers as he does to the subject on which he writes.

H. D

Our Bookshelf.

The Application of Science to the Steel Industry By Dr W H Hatfield (Edward De Mille Campbell Memorial Lecture, presented in Philadelphia, October 10, 1928, at the Tenth Annual Convention of the American Society for Steel Treating) Pp vii + 154 (Cleveland, Ohio American Society for Steel Treating, 1928)

THIS volume contains the substance of a series of lectures delivered by the author in the course of a visit to the United States during last autumn, and deals with modern developments in the manufacture and use of steel As chairman of the Steel Ingots Committee, Dr Hatfield naturally gives prominence to the work of that committee, and lays stress on the importance of ingot structure for the quality of the finished steel. This section forms a useful introduction to the subject, and is well illustrated The principles of heat treatment are next considered, again with the presentation of abundant material from technical practice

The metallurgist will naturally turn with great interest to the remaining four sections, dealing respectively with special engineering steels, corrosion resisting and stainless steels, steels intended for use at high temperatures, and with tool and cutlery steels On all these matters the author is in an exceptional position for the collection of full and accurate data, and his numerous tables form a most valuable compendium of information on such subjects In deference to the audiences before which the lectures were delivered, temperatures are given on the Fahrenheit scale, but the Centigrade values are added in brackets The author would render a service to metallurgy if he could persuade American workers to come into line with the rest of the world in this respect

Dr Hatfield has been very frank in including information which is often, for commercial reasons, difficult to obtain, and the volume, although small, will be frequently consulted, especially for the more complex alloy steels intended to resist creep at high temperatures, and other recent features of the industry. The references to the literature are abundant, but marred by numerous minor inaccuracies The author is to be congratulated on a very useful piece of work.

Praktische Einfuhrung in die Morphologie der Insekten · ein Hilfsbuch fur Lehrer, Studierende, und Entomophile Von Prof. Dr Eduard Handschin (Sammlung naturwissenschaftlicher Praktika, Band 16) Pp viii + 112 (Berlin Gebruder Borntraeger, 1928) 11 gold marks.

THIS handbook is designed to meet the need for a practical manual for the laboratory training of entomology students in the elements of insect morphology. Its plan of arrangement is that each chapter is devoted to a separate region of the insect body, and is preceded by a short list of papers useful to the student for further reading The author, it may be added, has borne in mind the importance of explaining structure in terms of function By means of a series of judiciously selected types the student is led to understand the significance of the chief structural modifications found among representative insects. A considerable number of common and usually easily procurable species are used as types for dissection, and having mastered the course laid down, the beginner should have acquired a sound general acquaintance with the external structure of these animals As a supplementary guide to practical work, a separate atlas of 23 plates is provided at the end of the book Its figures illustrate practically all features discussed in the text ; they are models of clarity and are for the most part original The book can be recommended as a concise and thoroughly accurate laboratory manual

A D IMMS

The Industrial Uses of Bauxite with an Account of its Origin, Occurrence, Composition, and Properties By Dr N V S Knibbs Pp. 141. (London Ernest Benn, Ltd , 1928) 21*s* net

DR KNIBBS's book is a valuable contribution to the literature relating to bauxite, and it is therefore very regrettable that the price is so high Nine of the fifteen chapters are concerned with the uses of bauxite, a subject about which published information is rather scanty After a brief account of its occurrence and properties, the uses of bauxite in the manufacture of aluminium and its compounds, alumina refractories, abrasives and aluminous cements, and in oil refining, are all fully described. In view of the great increase in the production of aluminium and the growth of a demand for aluminous cements, the possibility of a shortage of bauxite at some future date must be seriously considered, and in the concluding chapter Dr. Knibbs discusses the utilisation of clays as substitutes. Valuable lists of references are given at the ends of chapters.

Notions fondamentales de chimie organique Par Prof Charles Moureu Neuvième édition entièrement revue et augmentée de nouveaux chapitres Pp ix + 657 (Paris Gauthier-Villars et Cie, 1928) 70 francs

THE new French edition of this well-known textbook has been revised and brought up-to-date. Several interesting chapters have also been added, dealing with the following aspects of applied organic chemistry substances possessing odour (pp 26) or taste (pp 7), organic medicinals (pp 47) and explosives (pp 14) We may note that the first of the new chapters contains no mention of the striking osmophoric properties of organic sulphur and selenium, and that the revised account of the carbohydrates, which scarcely does justice to recent researches, could be expanded with advantage The book may be criticised in these and other details , but the enlarged version, regarded as a whole, is characterised by the sense of proportion, logical presentation, and clarity of exposition which distinguished Prof Moureu's original text

J. R

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

An Isotope of Oxygen of Mass 17 in the Earth's Atmosphere.

SINCE we reported the presence of an isotope of oxygen with mass 18 in the earth's atmosphere (NATURE, **123**, 318, 1929) we have found further confirmation Mr. Harold D Babcock has sent us thirty-four lines which were withheld from publication by Dieke and Babcock (*Proc N A S*, **13**, 670, 1927) because it was not known that they were due to oxygen Twenty-seven of these are due to the alternate rotation levels of the 18-16 oxygen molecule Thus the 18-16 molecule has every rotation state where the 16-16 molecule has only alternate levels Such an excellent confirmation of the predictions of wave mechanics in this regard has not heretofore been possible since the presence of nuclear spin usually permits all states to exist although not in equal amount. The more complete discussion of the data will appear elsewhere (*Jour Am. Chem Soc*, May 1929) In the meantime Babcock, who obtained the data at Mount Wilson Observatory, has re-examined his plates and also obtained additional measurements. He has found a number of extremely weak lines in addition to extending the various 18-16 series, and has kindly permitted us to examine his manuscript in advance of publication (*Proc. N A S*).

Babcock suggests that his new lines may be due to the forbidden 16-16 alternate rotation levels, although, as he points out, they fail to occupy the correct positions by several times his experimental error

We have found that these lines originate from a molecule consisting of an atom of mass 17 in combination with one of mass 16. The normal state of this molecule has one-half unit of vibration, and both odd and even rotation levels exist. Each of these facts is in accord with the theory of wave mechanics

The equations for the isotopic displacement are the same as previously given (NATURE, **123**, 318; 1929) except that 1·11 cm.$^{-1}$ and 0·0294 cm.$^{-1}$ should replace the values 2·12 cm.$^{-1}$ and 0 0556 cm.$^{-1}$ respectively. Out of 22 new weak lines we find that 19 belong to oxygen 16-17. The algebraic deviation of observed minus calculated lines is $-0·03$ cm.$^{-1}$ with a maximum deviation of 0·14 cm $^{-1}$.

It is apparent from the comment of Aston (NATURE, **123**, 488, 1929) with regard to oxygen 18 that a mass spectrograph is unreliable in an initial or confirmatory investigation of isotopes present in very small amount. It appears that the various known isotopes of the elements, their several chemical combinations and multiple ionisations, are not eliminated by existing technique, and suffice to explain nearly any future observation that can be made on an isotope present in very small amount. This is, however, not the case in band spectroscopy, where the very characteristic fine structure having been found for an abundant isotope will lead to an equally characteristic counterpart We may thus conclude with certainty that oxygen isotopes 17 and 18 do exist in the earth's atmosphere

Babcock has carried out some very accurate intensity measurements to assist in the estimation of relative amount. As we have pointed out in our more detailed paper (to appear *Jour. Am. Chem Soc.*, May 1929) 18-16 molecules may be slightly polar, due to zero point vibration. This would be expected, since the centre of mass does not coincide with the geometrical centre Such polarity may increase the absorption coefficient of the 18-16 or 17-16 molecules However, intensity measurements should lead to a maximum value Babcock estimates oxygen 18 as present to one part in 2500 He has, however, overlooked a factor of two in his calculation, so that the estimate should be one part in 1250, as a maximum. This factor is due to the fact that the 18-16 molecules have twice as many states in which to exist as have the 16-16 molecules.

From Babcock's estimate of the relative intensity of the lines which are due to the 17-16 molecule we estimate its abundance as about one part in 10,000 as a maximum

Oxygen mass 17 has been reported by Kirsch and Petterson (*Ark f. Mat Astron. och Physik*, Stockholm, 19, 15, 1-16, 1925: *Phys. Z*, **26**, 457, 1925) and by Blackett (*Proc. Roy. Soc*, A, **107**, 349, 1925) from data obtained on collisions between alpha particles and nitrogen nuclei. These collisions occasionally lead to combination with subsequent elimination of a proton leaving oxygen 17. These experiments did not indicate the stability of oxygen 17, except that Blackett was able to show a life of at least 0 001 sec.

A full account of our work will appear elsewhere.

W. F. GIAUQUE
H. L. JOHNSTON.

Department of Chemistry,
University of California,
Berkeley California,
April 27.

The Heat Production of Crustacean Nerve.

IN my Ludwig Mond Lecture, published in NATURE of May 11, I referred to the experiments of Furusawa on the 'depolarisation' of crab's nerve by stimulation, and to the manner in which the 'polarisation' (as shown by the injury current) increases again to its original value in the presence, but not in the absence, of oxygen. In a paper by Furusawa, shortly to be published in the *Journal of Physiology*, it will appear that this recovery process occupies a time of the order of half an hour I have recently succeeded in measuring the heat produced by crab's nerve, as the result of a 5 to 10 seconds' stimulus. Some 98 per cent of this heat occurs in the recovery phase, only 2 per cent during the actual stimulus. the recovery heat production lasts for 20 to 30 minutes at room temperature. There is no doubt, therefore, that the process in which the injury current, diminished by stimulation, returns to its original value is accompanied by a relatively large liberation of energy

A striking fact is the small amount of heat set free in the initial phase, that is, during the passage of the impulse If we regard the nerve wave as accompanied by a surface change in the fibre which momentarily allows electrical contact to occur between inside and outside (it is difficult to picture the 'action current' otherwise), then activity will allow an equalisation of concentration of ions to occur between the two sides, a process which must be reversed during subsequent recovery. The mixture of two salt solutions, say of potassium chloride and sodium chloride, involves very little change in total energy: considerable work, however, may be required to separate them again, and this work will require a provision of energy, and in any actual process the liberation of heat

The crustacean nerve, as shown by Levin and by Furusawa, is highly fatigable, at any rate in respect of its electric change. Corresponding to this, Meyerhof

and Schulz have shown in a recent paper in the *Biochemische Zeitschrift* that its oxygen consumption is high. reckoned per gram of *dry* nerve, when stimulated, twenty times as high as that of a frog's sciatic, at rest ten times as high. In a short stimulus I have found the total heat (initial plus recovery, spread over half an hour) to be about 2.5×10^{-3} calorie per gram of fresh nerve per second of stimulus, as compared with 7×10^{-5} calorie for the frog. The crab's nerve is non-medullated, the fibres of the frog's sciatic consist mainly of medullary sheath: this may be one cause of the large difference between the two. The fact that the crab's nerve contains a far higher percentage of water would work in the opposite direction.

Whether the striking differences in fatigability, depolarisation, recovery, and energy exchanges between these crabs' nerves and the sciatic of the frog are simply to be attributed to the fact that the former are non-medullated and the latter medullated, only future work can show. The central nervous system, which consists largely of nerve cells and to an appreciable extent of non-medullated fibres, is far more fatigable and more dependent on an adequate supply of oxygen than is the peripheral medullated nerve. It may well be the case that in the limb nerves of the crustaceans we have in such respects a much better model on which to work out the elementary properties of the nervous system than we find in the ordinary medullated nerve, which hitherto has been chiefly used for the purpose.

A. V. HILL.

University College,
London, W.C.1, May 14.

The Inland Waters of South Africa.

IN view of the forthcoming visit of the British Association to South Africa, we should like to direct the attention of biologists to certain remarkable inland waters occurring in that country. Throughout the southern half of the Transvaal, as well as in many other parts of South and South-west Africa, are found shallow saucer-like depressions of various sizes which may be filled temporarily or permanently with water. These pans have been ably described by Rogers,[1] and are generally admitted to be the result of wind erosion at a time when the climate of the country was drier than it is at present, although Passarge[2] considers them to have been the result of 'zoogenous' erosion in the Kalahari.

We have examined a considerable number of these localities both on the Witwatersrand and in the Lake Chrissie region of the Ermelo district, an area of uncertain drainage from the edges of which arise the Vaal, Komati, and Usutu Rivers, and within which a surprisingly large number of pans occur.

From a hydrobiological point of view the Transvaal pans may be divided into temporary and permanent waters. The *temporary pans* dry up in the latter part of the winter season, often leaving a few small pools, and fill with the first heavy summer rains. They may be referred to the 'astatic' type of Gajl,[3] and normally support a rich phyllopod (s. str.) fauna. We have found it convenient to subdivide the temporary pans of the southern Transvaal into *grass-pans* and *mud-pans*. The *p*H of the former is below 8.0 when full, and the soil of the bottom does not become sufficiently 'brak' to inhibit the growth of a rich terrestrial vegetation on drying. When full, such localities support a large number of aquatic flowering plants, and a very abundant and varied tychoplankton, characterised by the association of *Volvox* spp. with the rotifer *Conochilus hippocrepis*. The *mud-pans*, on the other hand, have a *p*H of more than 8.2 when full, and presumably their floor is too 'brak' when dry to allow the growth of abundant terrestrial vegetation. The plankton is far more restricted than is that of the *grass-pans*, phytoplankton is almost absent, and rotifers rare, the bulk of the organisms inhabiting such localities being crustacea.

In the Lake Chrissie area the majority of the pans are permanent. Chemical conditions are very variable and are reflected in corresponding differences in the fauna and flora. The most interesting condition was met with in a series of pans, all less than a mile in diameter and perhaps 10-20 feet deep. The water of these pans has a *p*H of about 9.0, is slightly salt (0.02-0.03 *N* Cl), coloured from pale yellow to deep sepia by humic material, and may be very turbid. Such pans support practically no higher vegetation or phytoplankton and have a zooplankton composed almost exclusively of one or two species of Centropagid copepods and a large and remarkable Daphniid. The largest pans, for example, Lake Chrissie itself, which is about three miles long, may support a rich growth of *Potamogeton Livingstonii* (Moss: forthcoming publication). In striking contrast to these pans may be mentioned a pair of pans lying close together on the farm Weltevreden to the south of Lake Chrissie. One of these, which is slightly alkaline, supports an exceedingly rich growth of *Melosira* and a few other algæ and is slightly alkaline, the other, which is just on the acid side of neutrality, contained large numbers of desmids and a very rich rhizopod and rotifer fauna.

Naumann,[4] in his latest contribution to lake typology, characterises the *dystrophic* type of water as being on the acid side of neutrality, poor in electrolytes and containing considerable amounts of humic matter, while the *oligotrophic* type of Thienemann[5] is divided into *oligotrophic* (s. str.) on the acid side and *alkalitrophic* on the alkaline side of neutrality. The more extreme type of permanent pan containing large amounts of humic matter must be considered as *dystrophic*, but differs from Naumann's characterisation not merely in alkalinity, but also in containing large amounts of electrolytes (chiefly sodium bicarbonate and sodium chloride with some calcium, magnesium, and sulphates), including accumulated phosphates, up to 0·006 mgm. P_2O_5 per litre, which cannot be utilised owing to the lack of phytoplankton. The poverty of the planktonic flora must be attributed to the combined influences of alkalinity, turbidity, and colour of the water as well as to the direct toxic action of the humic matter. Since both acid and alkaline waters may be classified as *dystrophic*, it would seem better to abandon the term *alkalitrophic* type and to revert to Thienemann's earlier scheme, recognising, however, an alkaline as well as an acid phase in the *oligotrophic* and *dystrophic*, if not in the *eutrophic* type. Other cases of *alkaline dystrophic* waters are probably recorded in the literature without their true nature being recognised, for example, Turner's Lake, Isle-au-Haut, Maine.[6] Dr. S. C. Ball also kindly informed us that very salt humic waters may occur in the lagoons of coral atolls when completely shut off from the sea. In such a case a *salt dystrophic* lake may be formed supporting only a population of *Artemia*.

[1] *South Afr. Jour. Sci.*, **19**, p. 1, 1922.
[2] "Die Kalahari", Berlin, 1904.
[3] *Bull. Int. Ac. Pol. Sci. Math.* (B), p. 13, 1924.
[4] "Grundlinien der experimentellen Planktonforschung. Binnengewässer VI", Stuttgart, p. 24, 1929.
[5] "Die Binnengewässer Mitteleuropas. Binnengewässer I", Stuttgart, p. 199, 1926.
[6] Bishop and Clarke, "A Scientific Survey of Turner's Lake", N.Y. State Mus., 1923.

Normal acid *dystrophic* waters also occur in South Africa, but are chiefly of artificial origin, for example, the various reservoirs on Table Mt from which the water supply of Cape Town is derived The Transvaal pans by no means exhaust the hydrobiological wealth of the country, on the Witwatersrand are found very acid waters (pH 3 7) contaminated with nitre cake from gold extraction works, which support a restricted fauna The alkaline vleis near Cape Town also deserve passing mention.

A detailed report on the chemical conditions and planktonic life of all these localities is in preparation and will be published as soon as our collections have been worked out by the various systematists who have kindly undertaken to examine them. Our very best thanks are due to Prof. L T. Hogben, of the University of Cape Town, who first directed our attention to the remarkable field offered by South Africa for this type of research, to Dr. A. W Rogers, director of the Geological Survey of South Africa, for bringing to our notice the Transvaal pans, to Prof. J A. Wilkinson, of the University of the Witwatersrand, who generously placed his facilities for chemical analysis at our disposal; and to Prof. C. E. Moss and his staff, of the same University, and to Miss E. L. Stephens, of the University of Cape Town, for valuable botanical information.

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April 25

Vegetation Formulæ.

THE value of floral formulæ in indicating at a glance the systematic position and affinities of a phanerogam has so long been recognised that no apology is needed for suggesting that a comparable means of expressing the general character of vegetation types is both eminently desirable and likely to prove of great value to the ecologist and phytogeographer. At the present time the personal factor inevitably enters largely not only into the description of vegetation, but also into the interpretation of descriptions. After some years of residence in the drier parts of India and Burma the *Acacia* thorn forest and *Acacia* scrub, both with an undergrowth mainly of grass, had become two of the most familiar types of vegetation, yet I was unprepared for the extraordinarily close comparison which is possible with large areas of the Bush Veld of Southern Rhodesia or with certain types of mulga scrub and mallee scrub which I found on visiting South and Western Australia. Yet a vegetation formula, such as is now proposed, would have indicated the affinity at a glance. It is essential that the formulæ shall be kept as simple as possible, so that they may be used by travellers and explorers with only a slight knowledge of botany, but will at the same time impart a valuable precision to their observations.

The formula depends upon two separate considerations

(*a*) The enumeration of plants over a definite standard area.
(*b*) The recognition of four or five main groups of plants for this purpose

It has long been the custom of forest officers to study their forests by 'sample plots' and of ecologists to base detailed descriptions on similar plots. It is proposed that one hectare be taken as the standard area. Of course the enumeration may be carried out over any sized area and the results reduced to the standard area Thus a hectare is equivalent to 2·47 (roughly $2\frac{1}{2}$) acres and is equal to 10,000 square metres, so that the enumeration of small plants may be made on the basis of a square metre. It is necessary to have a large standard area to cover adequately tropical vegetation where there may be but one or two individuals of a particular species even in a dense equatorial forest, or the widely scattered vegetation of a semi-desert.

It is suggested that, for practical purposes, the types of plants to be enumerated may be considered as divisible into five broad groups: trees (A from Lat. *arbor*), shrubs (F from Lat. *frutex*), herbaceous plants (H from Lat *herba*), grass (G from Lat. *gramen*), and cryptogams (C). It is recognised that *herba* is not a very satisfactory word, but its use in the sense proposed (excluding grass) is already widespread in the adjective herbaceous. The basal vegetation formula is thus:

$$xA + yF + zH + x'G + y'C,$$

where x, y, z, x', and y' are the numbers of individuals per hectare. For broad descriptive purposes it will often be possible to ignore C entirely.

For trees and shrubs the presence of more than one story may be indicated by duplicating the symbol thus:

$$A + A' + F + F',$$

whilst the general character of the trees or shrub may be indicated by suffixes such as e (evergreen), d (deciduous), c (coniferous). The average height of the vegetation is important and should be expressed in metres. For all types of vegetation the letters a, b, c, d, etc., may be used to indicate dominants, x, y, z, etc., to indicate the absence of dominants or presence of numerous species To take a very simple example:

$$150\ A^c a(30)$$

is the formula for a coniferous forest with one dominant (a), with an average height of 30 metres and averaging 150 trees to the hectare.

It is significant of the lack of precision in many of our existing descriptions of vegetation that I have not exact figures for any of the types of vegetation described in my "Vegetation of Burma" (1925) and in the *Journal of Ecology* (1923), but supplying estimates, four types of vegetation may be selected to indicate the use of the formulæ

(1) *Indaing*
$$= 300A^d abx(20) + 50F^d y + 10^4(2Hz + 10Gmnz').$$
(2) *Diospyros* forest
$$= 200A^d bcdex(12) + 50F^d y + 10^4(Hz + 10Gmnoz').$$
(3) *Acacia* thorn forest
$$= 150A^d efx(7) + 100F^d y + 10^2(5Hz + 20Gmnz').$$
(4) *Acacia* scrub
$$= OA + 150F^d efy(2) + 10^2(2Hz + 5Gz').$$

TREES a = *Dipterocarpus tuberculatus*, b = *Pentacme suavis*, c = *Terminalia tomentosa*, d = *Diospyros birmanica*, e = *Acacia catechu*, f = *Tectona hamiltonii*.
GRASSES: m = *Andropogum contortus*, n = *A. apicus*, o = *A. serratus*

It is obvious that the four examples chosen form a continuous gradation (actually the result of decreasing moisture).

If the principle of vegetation formulæ is acceptable to ecologists, numerous refinements and extensions will be necessary, but the present outline scheme is put forward with the hope that it may induce a greater precision of description by travellers. It is to be

noted that the formula is at least partially complete without the *naming* of the constituent species; it may also be noted that a formula can be drawn up from a study of scaled photographs, and even approximately in the case of forests from aerial photographs.

L. Dudley Stamp.

Popa, Ashtead,
Surrey.

Distribution of Temperature in the First 25 Kilometres over the Earth.

Sir Napier Shaw, in his "Manual of Meteorology", gives on p. 100 of vol. 2 a very interesting diagram showing the distribution of temperatures in the upper air over the globe. As pointed out by Dr. C. W. B. Normand in his review of the book in the *Quarterly Journal of the Royal Meteorological Society* (vol. 54, p. 275, 1928), the diagram does not represent exactly the peculiarities of the distribution of temperature in the stratosphere over the tropical and subtropical regions. An attempt has therefore been made to prepare a modified diagram, using all the data now available. It shows (Fig. 1) the probable distribution of isotherms in the atmosphere up to 25 km. in summer and winter over the northern hemisphere. The dotted lines are based on very few observations and are therefore mainly conjectural. The principal features of the diagram may be briefly summarised.

(1) The stratosphere is not isothermal over any particular place, but above a certain level there is a tendency for the temperature to increase with height.

(2) The coldest air over the earth, of temperature about 185° A., lies at a height of some 17 gkm. over the equator in the form of a flat ring surrounded by rings of warmer air.

(3) The surface of the tropopause has a relatively steep slope towards the pole between latitudes 30° and 50° in summer and between 25° and 45° in winter.

(4) The ring of lowest temperature at the tropopause is displaced towards the summer hemisphere.

(5) There is a ridge of high temperature in the tropopause between latitudes 20° and 40° N. in summer corresponding to the ridge of high pressure at 8 km. over those latitudes (see Sir Napier Shaw's chart of 8 km. isobars in July, *loc. cit.* p. 262).

The evidence for (1) and (2) comes from the results of sounding balloon ascents at Batavia, Agra, and in the United States of America (Blair, *Bull. Mt. Weather Obs.*, vol. 4, part 4, pp. 183-304, 1912). The rise of

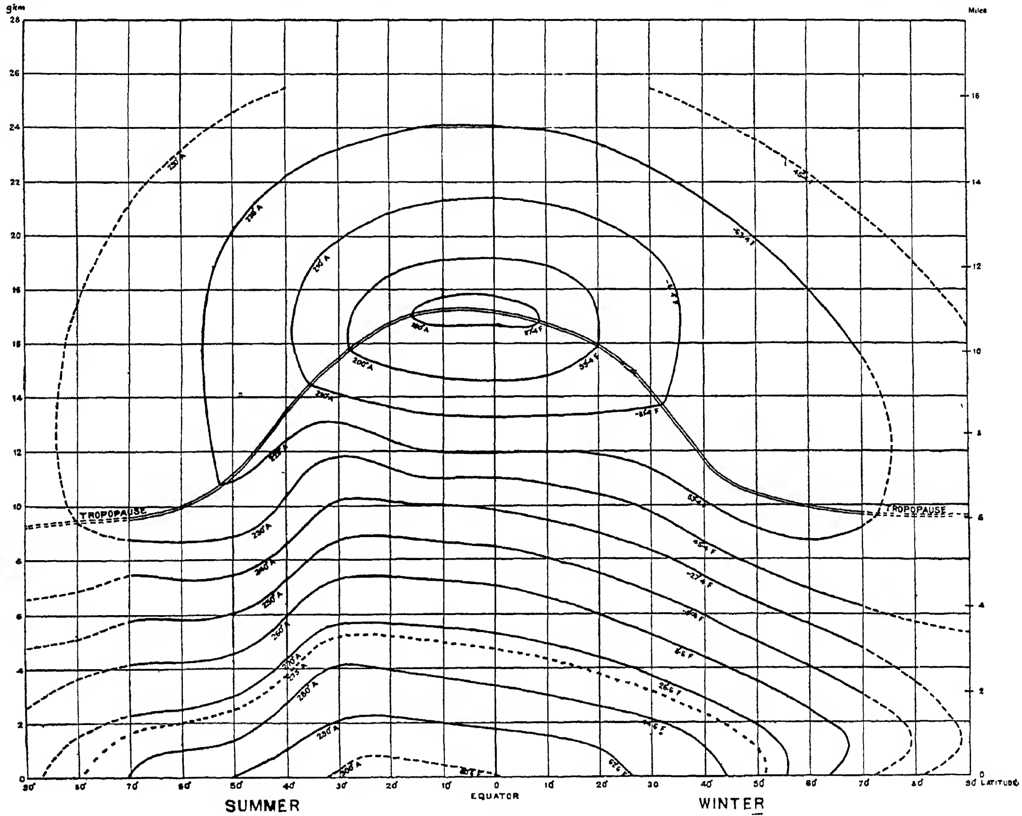

Fig. 1.

temperature with height in the stratosphere over these places cannot be considered to be due to insolation, as most of the Agra ascents and many of the American ascents began late in the day when the sun was low. Bemmelen has given strong reasons for believing that the rise of temperature in the stratosphere which he observed over Batavia could not have been due to insolation. The Agra and Batavia results indicate a temperature of about 220° A. at a height of 24 km., and the American results show about 230° A. at 25 km.

The seasonal variation of temperature of the tropopause at Batavia and Agra is illustrated in Fig. 2 and shows (4) clearly. The height of the tropopause over

Batavia does not show such well-marked variation as that of temperature, but the following figures taken from Bemmelen (*Proc Roy Acad*, Amsterdam,

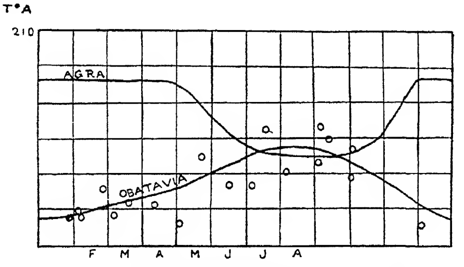

FIG 2 —The points marked in the figure refer to Batavia temperatures

vol 20, p 1313) show that the variation is similar to that which occurs over Agra but displaced by about six months

HEIGHTS OF TROPOPAUSE OVER BATAVIA (KM)

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
17 8	17 6	17 3	17 0	16 5	16 2	16 0	16 5	17 0	17 4	17 6	17 7

The lower temperatures and greater heights of the tropopause in summer are presumably due to the stronger convection in the troposphere in that season.

The persistent increase of temperature with height for at least 5 km. above the tropopause in the tropics finds a natural explanation if we assume that the tropopause marks the lower limit of the ozone layer in the atmosphere.

K R. RAMANATHAN.
Meteorological Department,
Poona, India

Significant Figures in Speed Records.

I HAD hoped that someone more competent than myself would have replied to Col O'Gorman's letter, in which, in NATURE of Mar. 30, he offered an apologia for recording Sir Henry Segrave's speed to 8 significant figures, but probably most readers of this journal do not consider that motor speed records form a subject with which they are intimately concerned It would, however, be regrettable if this silence led the general public to conclude that scientific workers are prepared to accept as valid a speed recorded to one hundred thousandth part of a mile per hour.

Col O'Gorman commences his letter by admitting that the last figures are merely arithmetical residues, with which all will agree, but unfortunately in what follows he seems to attempt to justify the inclusion of these readings in the published value of the speed. and to this objection may fairly be taken His first argument is based on the necessity for great precision in order that there may be no doubt whether a standing record has been beaten by a subsequent attempt or no Let us examine this argument a little more closely. Sir Henry Segrave's mean time for the mile over his two runs was 15 56 sec, the automatic timing being carried to 1/100 sec., and the mile apparently assumed to be absolutely accurate. A subsequent claimant to the record may do one of the following five things ·

1 He may beat the record by a substantial margin. in which case a statement to the nearest mile per hour would clearly be sufficient.

2 He may beat it by a narrow margin. We will take the nearest margin which can be recorded, one-half of one hundredth of a second (the time being the mean of two runs each of which is measured to 1/100 sec). This will make his time 15 555 sec, and his speed 231 44 miles per hour (or if we give the arithmetical residues, 231·43683 . . m.p.h.).

3 He may take precisely the same time to the half hundredth of a second as Sir Henry Segrave (15·56 sec) with a speed of 231 36 miles per hour.

4 He may take one-half hundredth of a second longer, when his speed will be 231 29 miles per hour.

5 He may fail to obtain the record by a substantial margin

Now in cases 2 and 4, to determine whether the claimant has obtained the record or not, it is amply sufficient to record the speed to 1/100th of a mile per hour. The difference from the standing record in each case amounts to 0 07 or 0 08 mile per hour. In case 3 no addition to the number of significant figures will serve to distinguish between the new record and the old. It is difficult to find any support for 8 significant figures from these facts.

Col. O'Gorman next points out that the speed published is not the true mean of the speeds obtained on the two runs over the measured distance, but the sum of the two distances divided by the sum of the two times It is not clear how this fact affects the question of the permissible number of significant figures, which is governed solely by the accuracy with which the time and the distance can be measured. One may further ask why, if it is wrong to round off to two decimal figures, it is right to stop at five figures? Why not publish a whole page of decimals ?

It would perhaps be presumption on my part to suggest a line of defence which Col. O'Gorman might have adopted, which could not be assailed on the scientific side He might have pointed out that these speeds to be accepted internationally must be worked out in the manner laid down by the international controlling body, and that any country which attempts a record and wishes its claim to be recognised must follow the prescribed rules The Royal Automobile Club, therefore, would be under an obligation to give the prescribed number of figures whatever this number might be. It may publish a foolish statement, but no alternative is open except that of not claiming the record, and few people would wish to push the claim for scientific honesty to this length.

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78 Denbigh Street,
S.W.1.

The Spread of Scale Insects and their Parasites.

MANY years ago I was an industrious collector of scale insects and mealy-bugs, especially in Jamaica I found them in great abundance on cultivated plants, and obtained many species When recently travelling in the Oriental tropics, I was struck by the relative scarcity of these insects, and the occurrence of various well-known injurious forms only in small patches or isolated individuals. Perhaps the difference was partly due to the relative poorness of my eyesight, but I could not help speculating on the causes which might lead to a diminution of scale insects on cultivated plants, aside from the operations of economic entomologists. World-wide commerce has spread the injurious Coccidæ over the earth, as they are so easily carried with plants. In their native countries they are efficiently controlled by parasitic and predatory enemies. In several well-known cases a plague has been abated by going to these countries and obtaining the natural enemies, which had failed to arrive with the first (accidental) importation of the coccids Thus, following the modern expansion of trade and rapid transit, there has been in many regions a great increase in the damage done by scale insects, at times reaching the magnitude of a calamity. But by the same process,

gradually but surely, the natural enemies will also spread. In the course of time, almost imperceptibly, they will gain the ascendancy, and the coccid plague will cease, never to return unless through the importation of a new sort of coccid Thus it may even happen in some cases that a rigid quarantine, after a pest has arrived, may be harmful, preventing natural enemies from following it. These latter may, however, be brought in by entomologists, through special permission, provided they have been found and recognised

There is some proof that this is not mere speculation I wrote to Dr. L. O. Howard, who has long paid special attention to the parasites of Coccidæ, and he directed my attention to a study he had made, comparing the scale-insect parasites of the United States (Chalcidoidea) with those he had studied and described in 1880. There was no doubt that in the years since that date the parasite fauna had changed owing to the introduction of many foreign species, which had in some cases supplanted native ones Furthermore, the recent researches of Garcia y Mercet in Spain, and Silvestri, Masi, and Paoli in Italy, indicated the existence in great numbers, in the Mediterranean region, of Aphelinine parasites apparently unknown there seventy-five years ago. Last year, when I visited the Melbourne Botanic Garden (which has about 16,000 species of plants growing in the open), Mr. St. John informed me that there were not nearly so many coccids on the plants as formerly This may partly be due to native enemies; thus the Red Wattle bird keeps the fluted scale (*Icerya purchasi*) in check; yet I suspect it may also be due largely to the spread of foreign parasites.

Similar-looking coccids may have quite different natural enemies The citrophilus mealy-bug (*Pseudococcus gahani*), though an ordinary-looking species, was not controlled in California by the many enemies of the native American mealy-bugs. Now, after an extended search, *Pseudococcus gahani* has been found apparently native in Australia, and two species of Hymenopterous parasites, a Dipterous parasite, two kinds of Coccinellid beetles, and a Chrysopa have been observed to keep it within bounds in that country. These have now been taken to California, and there are already indications of favourable results. California's plant quarantine would have prevented them from coming over accidentally, and in any case the deliberate work of the entomologists is infinitely superior to the slow operations of chance

T. D A COCKERELL.

University of Colorado,
Boulder, April 22.

Variation of the Intensities in the Helium Spectrum with the Velocity of the Exciting Electrons.

RECENTLY, Peteri and Elenbaas (*Zeits. f. Phys.*, **54**, p. 92, 1929) have published curves of the intensity variations of the helium lines when the velocity of the exciting electron steam is altered We have been working on the same subject, and since our results do not agree with theirs, it seems worth while to give a preliminary account of them

We also use a photographic method of measuring the intensities, but the apparatus for exciting the light is different. A narrow electron beam in helium at 0·024 mm. pressure passes into a field free box and produces a narrow streak of light. An image is thrown on to the spectrograph slit and runs perpendicular to it. We integrate the intensity over the length of the spectrum lines and subtract the background which is due to secondary excitation. In this way we completely avoid errors due (1) to secondary excitation, and (2) to the variation of the spatial distribution of the electron beam with the applied voltage.

The results for the lines 3889 ($2^3S - 3^3P$) and 3965 ($2^1S - 4^1P$) are shown in Fig 1 The scale for the two lines is arranged for the maximum of the two curves to be equal. The results of the Utrecht workers are shown dotted for comparison. We cannot explain their curves except by the supposition that a large fraction of the light from their tube was due to excitation by secondary electrons

The interesting feature of our curves is the extremely different behaviour of the singlet and the

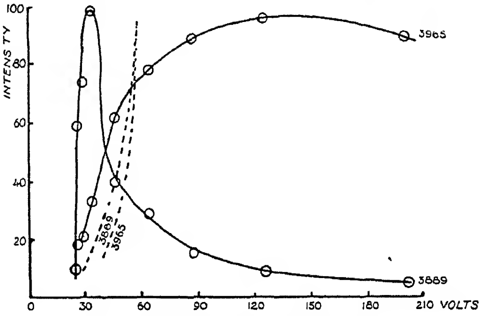

FIG 1 —Intensities in the helium spectrum

triplet lines. This is a general characteristic of all the lines, though individual cases show minor variations The following conclusions may be stated.

(1) For high exciting velocities, the triplets vanish in intensity compared with the singlets. This has been predicted theoretically by Oppenheimer, and had previously been found experimentally by Hughes and Lowe (*Proc. Roy. Soc*, A, **104**, p. 489; 1923), with whose results ours agree very well in general.

(2) For low exciting velocities, the singlets are weak compared with the triplets. This is a new result. Since the normal state of He is a singlet state, this seems to indicate for low velocities a very close coupling of the spin of the exciting electron with the spins of the electrons in the atom.

There is another interesting point of dissimilarity between the singlets and triplets. We find that while the light of the triplets is confined closely to the electron beam, the light from the singlets tends to spread away from it This makes the intensity determinations of the singlets somewhat arbitrary. We are not at the moment prepared to discuss the cause of this behaviour as the investigations are not yet complete.

J. H. LEES.
H. W. B. SKINNER.

H. H. Wills Physical Laboratory,
The University, Bristol,
May 7.

The Longitudinal Distribution of Photoelectrons.

THE new quantum mechanics has completely resolved the problem of the photoelectric effect. In fact, Wentzel (*Zeit. fur Phys*, **40**, 574, 1925 **41**, 828; 1927) and Beck (*Zeit. fur Phys.*, **41**, 443, 1927) have succeeded in justifying theoretically the well-known Einstein equation, and the more complete treatment of Sommerfeld has permitted the calculation of the dissymmetry of the photoemission, that is, the experimental fact that the forward emitted electrons are in a greater number than the backward ones. Sommer-

feld's theory is, however, a first approximation, valid only when the wave-length λ of the incident rays is fairly large compared with the dimensions of the atomic radius With these conditions, considering electrons emitted from the K level, the probability $P(\theta)d\theta$ of emission of a photoelectron at an angle comprised between θ and $\theta + d\theta$ is proportional to

$$\left\{1+\frac{18}{5}\frac{v}{c}\cos\theta\right\}\sin^3\theta d\theta \qquad . \quad . \quad (1)$$

and the mean impulse σ acquired by the electrons in the direction of the propagation of the rays is given by

$$\sigma\frac{h\nu}{c}=\frac{18}{5}\,\frac{4}{10}\,\frac{h\nu}{c}=1{\cdot}44\frac{h\nu}{c}.$$

Williams (NATURE, April 13, 1929) has demonstrated that this formula is in agreement with the experimental results, because recent experiments made in nitrogen and in oxygen lead to a value of σ ($\sigma = 1{\cdot}40$), nearly equal to the theoretical one

Equation (1) is, however, only a first approximation, and it remains to be determined what is the formula of distribution valid when Sommerfeld's approximation is not enough. We have made the calculation for the K level without any limitations for the value of λ. We have obtained a very complicated formula, that in a first approximation, when

$$\lambda \gg \frac{h}{2mc},$$

gives the (1), and in a second approximation leads to the following expression:

$$\left\{1+\frac{18}{5}\frac{v}{c}\left[1-\frac{135}{56}\frac{RhZ^2}{mc^2}+\frac{45}{112}\frac{v^2}{c^2}\right]\cos\theta\right\}\sin^2\theta d\theta$$

where R, h, m, c, and Z are well-known constants.

Substituting for these their values, we have

$$\left\{1+\frac{18}{5}\frac{v}{c}[1-6{\cdot}41\times10^{-5}Z^2+0\ 40]\cos\theta\right\}\sin^3\theta d\theta. \quad (2)$$

According to (2), in the second approximation we have a variation from Sommerfeld's value, depending upon the atomic number Z, but of little entity, and a greater variation from the velocity of the photoelectron in the opposite sense. The agreement obtained in the case considered by Williams remains also in the second approximation. In fact, for nitrogen ($Z = 7$) irradiated with rays of $\lambda = 0{\cdot}6$, the ratio v/c is equal to 0·28, and formula (2) gives for σ quite the same value as formula (1) ($\sigma = 1{\cdot}41$).

The deviations from the value of σ calculated by (1) are sensible for the heavier elements. In fact, if one obtains with $v/c = 0{\cdot}1$, $\sigma = 1{\cdot}40$ for argon ($Z = 18$), which is a value a little different from that of Sommerfeld, for krypton ($Z = 36$) one obtains $\sigma = 1\ 33$.

For very hard rays the effect of the second order, depending on the velocity, is more conspicuous. So if v/c is equal to 0·6, one obtains for argon $\sigma = 1{\cdot}61$, and for krypton $\sigma = 1{\cdot}53$. These values are not in agreement with those obtained by Augier for argon.

Further experiments may decide this question.

Details of the calculation will be published elsewhere.

ANTONIO CARRELLI.

Istituto Fisico, R. Università,
Napoli, May 3.

Dragonflies in Folk-lore.

IN recent years NATURE has adopted the very interesting departure of taking notice, by review or otherwise, of contemporary novels which hold some special interest for science, either (as in the case of H. G. Wells's "William Clissold") because of the recognised biological outlook of the author, or (as in the case of Aldous Huxley's "Point Counterpoint") because of some exceptionally expressed criticism of modern science, its aims or its outlook.

This attitude might well be adopted also towards novels which contain accounts or records of the popular outlook in times past towards natural objects, whether living or inanimate. Recently it has been my good fortune to read a novel which has already been acclaimed as a modern masterpiece, namely, the late Mary Webb's "Precious Bane" It is full of quaint, archaically expressed observations of Nature in the countryside. The time is about the end of the Napoleonic wars The chapter on dragonflies (book 3, chap v.) is well worth reading from this point of view alone, and I would like to ask readers of NATURE whether any of the expressions in the following passage are still in use in Great Britain:

"We called the dragonfly the ether's mon or ether's nild at Sarn, for it was supposed that where the adder, or ether, lay hid in the grass, there above hovered the ether's mon as a warning. One kind, all blue, we called the kingfisher, another one, with a very thin body, the darning-needle. Mother was used to tell Gideon that if he took dog's leave or did other mischief the devil would take needle to him and use the dragonflies to sew up his ears, so he couldna hear the comfortable word of God and would come to damnation. But I never could believe that the devil could have power over such a fair thing as a dragonfly."

I believe dragonflies are still quite commonly called "devil's darning-needles" in many parts of the United States of America, but whether the adder is still called the "ether", or the dragon-fly the "ether's mon" or "ether's nild" in any part of England or America I do not know. Perhaps some readers of NATURE could enlighten me.

The species called the "kingfisher" would evidently be *Calopteryx virgo* L., while the "darning-needle" must have been either *Agrion puella* L. or some other common damsel-fly, perhaps *Enallagma cyathigerum* Charp

R. J. TILLYARD

Canberra, F C T.,
Australia, Mar 31.

Periodic and Spiral Forms of Crystallisation.

IN a recent letter to NATURE (April 20, p. 603), Hughes has suggested that the interesting spiral markings on carborundum reported by Menzies and Sloat (Mar. 9, p. 348) may be a special case of periodic crystallisation. Hughes refers to a remark in a paper by Miss Henley and myself (*J. C. S.*, 2725; 1928) concerning the formation of spirals in Liesegang rings as anomalies caused by accidental external conditions.

The periodic crystallisation of thin films of sulphur described by Hughes was previously investigated by Fischer-Treuenfeld (*Kolloid-Z.*, **16**, 109; 1915) and by Kohler (*ibid*, **17**, 10; 1915), and an account of this and other examples of the same phenomenon is given in Hedges and Myers' "Physico-chemical Periodicity" (Arnold and Co., 1926) on pp. 34-37.

Some months ago I carried out some experiments on the crystallisation of thin films of molten organic substances and found that crystallisation in concentric rings readily takes place with benzil, benzoin, benzophenone, menthol, *m*-dinitrobenzene, and acetanilide. The experiments were discontinued, but I hope to return to them shortly: at present, the observations made are in the main in agreement with the views expressed by Hughes on the cause of the phenomenon.

I have examined the specimens to see whether there is any indication of the occasional formation of spirals in place of the usual concentric rings. The accom-

panying photograph (Fig. 1) clearly depicts the spiral growth of crystals This specimen was made in Sir Henry Miers' laboratory at Manchester in 1924 by allowing a thin film of potassium dichromate solution to evaporate on a warm microscope slide. The structure differs from that of the specimen of sulphur in Hughes's illustration and from most of my specimens, in that crystallisation started from the periphery of the drop and travelled inwards, instead of beginning

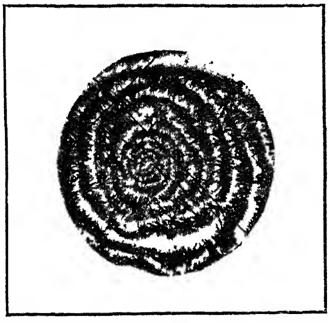

FIG. 1—Spiral crystal growth × 25 diameters

at a central nucleus and radiating outwards. The specimen of carborundum described by Menzies and Sloat may have crystallised in this way.

Where crystallisation starts from a central nucleus, I have not observed among the specimens an example of the immediate development of a spiral, but I have a specimen of camphorsulphonic acid, crystallised from ethyl acetate solution, in which a true spiral succeeds two concentric rings surrounding the nucleus of crystallisation Moreover, examination shows that a disturbance has been caused at the point where the spiral begins by the presence of another nucleus in the vicinity

There appears to be no doubt, therefore, that crystallisation does sometimes follow a spiral course to give a variety of periodic structure, and it seems probable that the markings on carborundum are to be explained in this way. ERNEST S HEDGES.

Bedford College (University of London),
Regent's Park, N W 1

The Atomic Weight of Phosphorus.

IN a recent issue of NATURE (Mar. 9, p. 390) mention is made of the fact that the English Commission on Atomic Weights adopts for the atomic weight of phosphorus the value 30·98(2), this being based on Aston's results with the mass-spectrograph; whereas the German Commission adheres to the older and higher value 31·02, derived mainly from gravimetric analysis.

The following results, obtained by the physicochemical method of density and compressibility as applied to phosphine gas, may therefore be of interest·

Density L_0^{760} at one atmosphere, 1·5317.

Density L_0^{760} at one-half atmosphere, 1 5243.

Assuming the compressibility factor to be a linear one, the value for $(1+\lambda)$ so obtained is 1·0097, which, in conjunction with the values for oxygen of 1·4290 for the normal density and 1·0009 for $(1+\lambda)$, leads to the molecular weight of 34·00(2) for phosphine and to 30·97(9) for the atomic weight of phosphorus.

Further experiments are being carried out at the pressures of three-quarters and one-quarter atmosphere, to ascertain whether the compressibility can be taken as a linear function of the pressure. Such results as have been obtained at one-quarter atmosphere give the value $L_0^{760}=1{\cdot}5208$ for which $(1+\lambda)=1{\cdot}0096$ and $P=30{\cdot}98(2)$. MOWBRAY RITCHIE.

Department of Chemistry,
University of Edinburgh,
April 30.

The Atomic Weight of Copper.

WITH reference to the Research item in NATURE of April 27, p. 660, that Messrs Richards and Phillips have recently found the atomic weight of copper to be 63·557 (Ag = 107·88), it may be interesting to note that the spectroscopic value given in my "Analysis of Spectra" (p 127) is 63·5569 ± 0·060, the 0·06 referring to maximum possible errors The probable error is much less. The value obtained on spectroscopic data depends on the doublet separation and the $p(1)$ term These are known with very great accuracy in both silver and copper.

W. M HICKS.

Quantum Geometry.

DIRAC's wave equation for the electron involves a Hamiltonian linear in the momenta p_k. This fact seems to be of geometrical nature and suggests the introduction of a linear fundamental differential form

$$ds=\sum_k \gamma_k dx_k$$

with matrix coefficients γ_k in geometrical considerations

This linear ds is connected with Dirac's wave equation in the same way as the Riemannian ds^2 with the relativistic wave equation of the older theory.

The matrix vector γ_k may be interpreted as an operator corresponding to the fundamental velocity, namely, that of light, and is connected with the Einsteinian $h_{\nu a}$ by the relation $\gamma_\nu=\sum_a h_{\nu a}\gamma_a^0$ where γ_a^0 are Dirac's constant matrices.

Possibly other tensors of the second rank, like the energy tensor T_{ik}, or R_{ik} are to be replaced in the proposed 'linear geometry' by matrix vectors in the same way as g_{ik} is replaced by γ_k

The linear geometry seems to furnish a basis on which a uniform theory of gravitation, radiation, and quantum phenomena is to be constructed. More detailed considerations on this subject will appear in the *Zeit. f. Physik.* V. FOCK.
D. IWANENKO.

Physical Institute of the University,
Leningrad, Mar. 21.

Early Use of Iron.

THE early history of iron outlined in the address by Prof. Louis (NATURE, May 18, p. 762) has been carried much further back by discoveries in South Palestine, published in *Gerar* last year. Furnaces were found dated to 1100 and 1175 B.C.; the earlier was 67 in. × 36 in. At the side of the furnace lay great hoes, 11 in. × 5 in., plough socks, and a pick of 6 pounds weight, showing that iron was as commonly used then as now. The earliest example was a knife of 1350 B.C, and this accords with the date of the polished steel dagger of Tutankhamen. This year another steel dagger, with cast bronze handle, has been found, of about 1300 B.C; as it was snapped in two anciently without any bending, it could not be soft iron. FLINDERS PETRIE.

University College, W.C.1.

Einstein's and other Unitary Field Theories: An Explanation for the General Reader.

By Prof H T. H PIAGGIO.

THE announcement of the publication of Einstein's new theory has aroused great interest even among those who do not usually follow the advances of science Unfortunately, this interest has been accompanied by a feeling that the new theory, like Einstein's earlier ones, is a mysterious mixture of metaphysics and mathematics. so obscure and paradoxical that the average man cannot possibly acquire any notion of what it is all about Indeed, a French author declared that "when two German professors meet, and each can understand what he says himself, but cannot understand the other, they are said to be talking Metaphysics If, however, the subject of discussion is so profound that they are unable to understand not only each other, but even themselves, it is called the Higher Metaphysics Now Einstein's Theory belongs to the Higher Metaphysics"

The purpose of the present article is to dispel such views By going back to the work of Newton and Maxwell we can trace the general nature of the ideas that have been uppermost in Einstein's mind It will be shown how the desire for unification of apparently different physical phenomena was the guiding force in each case Other attempts at unification of gravitation and electromagnetism will be explained and contrasted with Einstein's It is hoped that, by simple considerations concerning the meridians and parallels of longitude on the earth's surface, readers without any mathematical knowledge may be able to grasp the general nature of the principles underlying the new geometries

NEWTON AND GRAVITATION

When Newton (1642–1727) started to consider the subject of planetary motions, he found in existence fairly accurate knowledge of the facts, but only the wildest speculations as to the underlying causes Thus Kepler (1571–1630), by analysing the astronomical observations of Tycho Brahe (1546–1601), had found three laws of planetary motion One of these was that the orbits were ellipses with the sun in the focus. Kepler even guessed that universal gravitation might have something to do with these laws, but he also considered them as partly due to a magnetic force set up by the sun's rotation. Descartes (1596–1650) thought that space was filled with vortices of ether, and the planets were dragged round by these vortices like sand particles in a whirlwind

It was Newton's magnificent combination of physical intuition and mathematical power that enabled him to sweep aside these vague ideas, and to set up what we may call a unitary theory, which explained on a single basis effects hitherto believed to be due to more than one source He showed that gravitation alone, acting between every two particles of the universe with a force proportional to the product of the masses divided by the square of the distance between them, was sufficient to account for all the phenomena of planetary motion It is interesting to notice that at first Newton's theory of gravitation appeared to be disproved by the observed facts concerning the moon and the earth. This caused Newton to put aside his ideas for several years When a more accurate set of observations was available the theory was vindicated Its substantial correctness is conclusively proved every year by the truth, to a very close approximation, of the astronomical predictions of the *Nautical Almanac*

MAXWELL AND ELECTROMAGNETISM.

We now come to the twin sciences of electricity and magnetism The investigation of their mutual relationship was due to several investigators, among whom Faraday (1791–1867) takes a prominent place Then came Maxwell (1831–1879), who, in what are now well known as "Maxwell's Electromagnetic Equations", gave mathematical form to Faraday's ideas and extended them Maxwell's theories, which united electromagnetism and light, were criticised at the time, and even Lord Kelvin was of opinion that "up to the present the so-called Electromagnetic Theory of Light does not seem to have accomplished much". One term in Maxwell's equations (representing what is called a displacement current) seemed to owe its origin to an illegitimate union of mathematics and metaphysics. Worst of all, there seemed no experimental verification of the consequences of the equations. This was not forthcoming until after Maxwell's death, and was due to Hertz (1857–1894) The electric waves the existence of which was implied by Maxwell's equations were actually produced, and they may now be received every night by the millions who listen to radio concerts

EINSTEIN'S SPECIAL THEORY (1905).

Long after Maxwell's equations had been firmly established for a fixed system, there was grave doubt as to how they should be extended to a moving one In order to explain the results of the famous Michelson-Morley experiment, FitzGerald and Lorentz introduced the remarkable hypothesis of a contraction caused by motion Einstein (1879–) showed that the phenomena could be accounted for on the basis of the hypothesis that the velocity of light and all other electromagnetic phenomena would be exactly the same for two observers who were moving with uniform velocity relative to each other This was based on the measurement of time by light signals, an idea which seemed fantastic in those days, but an equivalent idea, the fixing of time by electromagnetic signals sent out by radio from Daventry or Paris, has now become a commonplace in many households

Those who scoffed at the idea of time being anything but an absolute quantity must now see that it is at least possible that the clocks regulated by

the radio signals from the Eiffel Tower, based upon observations at the Paris Observatory, might not agree exactly with those sent out from Daventry and based on observations at Greenwich This discrepancy, conceivable in any case, would become more so if France and the Eiffel Tower were moving away from Daventry with enormous velocity But the contraction of rods and the slowing down of clocks, to which so much attention has been directed, are (as pointed out by Eddington) only apparent Nothing really happens, except that each observer is unable to get an accurate idea of what length and time really are in the other system The only accurate way to take measurements in a system is to travel with it, and if this is impracticable, as in the case of an electron moving with a speed which is an appreciable fraction of that of light, our measurements of both space and time concerning the electron are slightly different from what they would have been if we could have travelled with it These slight differences are related to each other This is what we mean when we say that space and time form a four-dimensional continuum

There is no need to try to imagine a fourth dimension, but calculations, to be accurate in the case of high velocities, must deal with time as well as with the three dimensions of space. In this sense the theory united space with time, and so was a unitary one It also united electricity more closely with magnetism, for it showed that what appears to be a purely magnetic field in one system will appear to be a purely electric field in another system moving relative to the first Moreover, it united mass (inertia) and energy, showing that one can be transformed into the other. This has since been confirmed in the case of the helium atom, the mass of which is slightly less than the sum of the masses of the nucleus and the electrons which compose it The discrepancy is made up by the potential energy stored up when the electrons and nucleus are packed closely together

In spite of this discussion of mass and energy, we can say broadly that Einstein's Special Theory was fundamentally an electromagnetic one, having no connexion with gravitation. Its experimental basis was a slender one, and even such as it is, it has been called in question by Miller, who claims to have obtained, at great distances above sea-level, evidence of the ether-drag of which Michelson and Morley, at about sea-level, found no trace (In spite of the elaborate precautions against error that Miller took, there is a general disposition to reject his results) Perhaps the chief service rendered to science by the Special Theory was the help it gave in arriving at the general one, with which we will now deal

Physical Basis of Einstein's General Theory (1915)

In the dynamics of Newton, the same number, the *mass*, appears to measure three entirely different properties, namely, the quantity of matter, the inertia (or difficulty of setting it in motion), and the weight (the force exerted on it by the earth). Is this merely a marvellous coincidence? Einstein thought not, and inferred that inertia and weight are probably two aspects of the same phenomenon, due to something in the nature of space (or rather of space-time) Again, everyone knows the queer feeling of falling when a lift starts to descend, or of heaviness when a descending lift is coming to rest Weight, in fact, seems to alter when in a system, like a lift, which can be accelerated

This suggests a connexion with relative motion, which, for uniform velocity, was considered in the Special Theory These considerations led Einstein to seek hypotheses concerning space and time which would incorporate the results of his former theory and at the same time account for inertia and gravitation In other words, he was led to seek a new geometry

Abstract and Physical Geometry

How can there be a new geometry? Most of us had it fixed in our minds that geometry was a fixed and unalterable science Did not Euclid, starting with axioms that were self-evident truths, reach conclusions which will stand for all time and, moreover, can be verified by sufficiently careful drawing? This is certainly what we gathered from Blank and Dash's "Geometry for Schools", but it rests upon a confusion of ideas

First of all, there are two distinct kinds of geometry, abstract and physical. The first starts with certain *undefined* terms, such as point, straight line, and plane, and makes certain *unproved* statements, called axioms (or postulates), about them. Then we deduce consequences from these definitions and axioms, which constitute abstract geometry. The whole structure is purely a sort of building game, in which the definitions and axioms, taken more or less at random, furnish the bricks, and we see what we can build with them There is no necessary connexion with the physical world, and so it is meaningless to inquire whether the axioms are true or self-evident To vary the metaphor, they are the rules of the game, and may be changed at will if we want to construct a new game Euclid's geometry in its ideal form, when it reasons entirely from the definitions and axioms (an ideal not realised in any school geometry), is one system of abstract geometry. But so long as the science is only an abstract one, we are at liberty to start with a set of axioms quite different from those of Euclid. We shall see later that by studying the properties of a sphere we can build up a system called Riemannian geometry, of which Einstein makes great use

We now come to physical geometry, the science that deals with the results of the draughtsman, the surveyor, and the architect, and expresses the properties of rulers, set-squares, plumb-lines, and other physical objects. Of course, Poincaré was right when he asserted that we can assume any system of geometry we like (and no doubt most of us prefer the simplest, namely, Euclidean), and then explain any observed physical phenomenon, however strange, by attributing it to some physical force However, Einstein preferred to proceed otherwise, and exercised his free choice of an

abstract geometry in such a way as to sacrifice some of the simplicity in the geometry to gain as much as possible in the physics. For example, in his theory there is no need of a gravitational force to make a planet move in its orbit, for this orbit is as natural in his geometry as is a straight line in the geometry of Euclid and Newton This is what is meant by 'the geometrisation of physics', and we may define physical geometry as that one of the many possible systems of abstract geometry which is most successful in giving a simple account of physical phenomena. The experience of draughtsmen and others shows that Euclidean geometry works very well indeed in ordinary terrestrial affairs, so physical geometry cannot differ very much from Euclidean.

The Origin of Adaptations.[1]

By Dr E. J ALLEN, F R S

BY an adaptation is meant nothing more than a character of an organism, which has enabled a species to survive itself as such, or to survive until it is transformed into another species. It is survival that gives the measure of the value of the adaptation. Survival can only occur if the whole organism is adapted to the environment to an extent that suffices Organism and environment must be thought of as a unity, as interlocked and fitted closely to form that harmony which is Nature and life Organic evolution is a phase—the crowning phase, may be—of cosmic evolution The biological environment determines survival no less than the physical, and adaptation to both must be sufficient. The environment is not fixed, but must be thought of as in a condition of perpetual flux and change. This is true especially of the biological environment, for species once common may practically disappear, and years later may reappear abundantly with devastating effect on other organisms

The general physical conditions under which organisms live have been well discussed by L J. Henderson in his book "The Fitness of the Environment" (1913) Henderson discusses the unique properties of water, carbonic acid, hydrogen, and oxygen, and shows how they are specially fitted for the purposes of organic life "There are no other compounds which share more than a small part of the qualities of fitness of water and carbonic acid; no other elements which share those of carbon, hydrogen, and oxygen" "None of the characteristics of these substances is known to be unfit or seriously inferior to the same characteristics in any other substance" "The fitness of the environment is one part of a reciprocal relationship of which the fitness of the organism is the other."

Darwin's answer to the question, how does the adaptation of organism to environment come to be, was based on three factors—heredity, variation, selection. In ultimate analysis the fact of heredity depends on the cellular structure of organisms and the phenomenon of cell division. When a living cell divides, its most essential substance, the germ plasm, separates into two portions which are almost equal. But we cannot so easily obtain an insight into the problem of variation For simplicity's sake, consider first the formation of a germ cell from its mother cell in an organism which is developing parthenogenetically. The researches of the colloid chemist have given us the picture In imagination enlarge the germ mother-cell until you see the two phases, the liquid, the mass of molecular aggregates varied in size and shape, until you see the long, complex chains of atoms, building up the heavy molecules which form the aggregates; until you see the solar systems in miniature of protons and electrons which are the atoms—a seething, churning mass, active with the activity of cosmic forces, receiving matter and energy constantly from the surrounding medium, and giving them back The preparations for cell-division begin, the molecular aggregates arrange themselves in new patterns, the separation of the cell into two parts ensues Is it a matter for surprise that the partition of pattern and of substance is not always, perhaps is never, exact? We cannot wonder that germ cells thus produced differ in small respects among themselves. A few molecules more or less, a few atoms more or less, a few electrons even more or less, may mean large changes in the offspring into which the germ cell grows We are, I think, safe in concluding that lack of equality in the partition of the hereditary material is one important cause of variation If we think on similar lines of sexual development, where instead of one we have two germ cells uniting to form the zygote from which the offspring is developed, the probability of variation between parent and offspring, and between different offspring of the same parent, is obviously much increased

Weismann was the first to draw a clear and sharp distinction between true hereditary characters and modifications of the body or soma, produced by the direct action of physical changes in the environment, and to develop the conception of the continuity of the germ-plasm. The germ-plasm is the transmitter, in unbroken continuity from generation to generation, of hereditary qualities The body or soma is its temporary guardian, perishing when the work of transmission has been done. Blastogenic characters, as Weismann called the true hereditary characters, reappear in exactly the same form in the offspring as they show in the parent, provided both parent and offspring have grown up in the normal environment. Few now question that the nucleus is the essential organ of the germ cell which is engaged in the transmission of hereditary characters. Few

[1] Extracted from the Hooker Lecture, delivered before the Linnean Society of London on Mar 14.

also question that the chromatin of the nucleus is the bearer of definite factors or genes, or that these factors are distributed in linear order in the chromosomes which appear at the time of cell-division In ordinary normal development, hereditary characters are determined by the factors in the germ-plasm in response to stimuli furnished by the environment, for in the absence of a suitable environment no development at all takes place If the environment is normal the characters are reproduced in normal form.

Hereditary *variations* are differences from the parental characters, which appear in the offspring, and are transmitted by the offspring to its descendants We can only study them when the environmental conditions, in so far as they affect the characters concerned, remain unchanged throughout the growth of both parent and offspring, and this is the recognised basis of all breeding experiments These hereditary or blastogenic variations we now call mutations, and mutations, according to the most recent usage of the word, may be either large or small, it being quite impossible to distinguish them from any other variations by the factor of size alone In this respect the word mutation as now used does not convey exactly the same idea—it is not so limited—as Darwin's words 'sport' or 'monstrosity', and its meaning has been somewhat changed since it was first introduced by de Vries. The modern view is that mutations are heritable changes in the characters of organisms, which are due to definite alterations of the factors or genes, situated in the chromosomes of the germ cells Contrasted with these mutations we have somatic modifications, the acquired characters of Weismann, the reaction of the organism to definite changes in the environment. De Vries's term 'fluctuations' is now generally employed in the same sense, and has, I think, ceased to be useful

The variations or deviations revealed by the measurements of biometricians, which group themselves around a mean or modal value, according to the 'law of error', are probably in part small mutations which can be transmitted to descendants, and in part somatic modifications which are not so transmitted. With adequate measurements for a series of consecutive generations, the statistical tests which the biometrician applies enable him to say whether or not any of these deviations are inherited, and to give a measure of that inheritance. To take an example, it is frequently maintained that Johannsen's experiments with garden beans (*Phaseolus vulgaris nana*), which multiply by self-fertilisation and from which he obtained what he regards as pure lines, have proved that individual differences as shown by these lines are not inherited, and that therefore they cannot provide material upon which natural selection can act Pearson, however, maintained, so long ago as 1910, that the pure line theory demands that the offspring shall be as highly correlated with the grandparent as it is with the parent, whereas Johannsen's own figures show that the coefficient of correlation between offspring and parent is higher than that between offspring and grandparent These experiments should be repeated with larger numbers of measurements

Mutations may be classified into 'combination mutations', those due to rearrangement of factors or genes already present, and 'alteration mutations' due to changes in the factors themselves. Evidence is now forthcoming that the germ-plasm itself can be acted on by physical and chemical forces in the environment in such a way that mutations are produced. Heslop Harrison's work on the production of melanic forms in Geometrid moths was described (see NATURE, Jan 22, 1927, p 127) This work is of outstanding interest, not only on account of the fundamental importance of the results attained, but also for its perfect combination of acute and penetrating observations in the field with critical and long-sustained experimentation Harrison has shown quite clearly that the germ-plasm can be changed by chemical substances contained in the food of an animal, or in more general terms that the germ-plasm can be altered by the environment Another important advance in the same direction has come in H J. Muller's account (*Science*, July 1927) of his production of mutations in *Drosophila* by irradiating spermatozoa or oocytes with X-rays When the correct dosage had been found, many mutations were produced, which on the whole were similar to those previously reported in *Drosophila*, such as 'white eye', 'miniature wing', and 'forked-bristles' Most were recessive, but a number were dominant

One further point with regard to variations must be noted The possibilities of variation of an organism are strictly limited and circumscribed by the general physical and chemical properties of protoplasm The essential physiological processes, upon which the life and activity of organisms depend, are comparatively few. Digestion, growth, sexual activity follow the same general lines throughout the whole animal kingdom It is probable that the physico-chemical mechanisms alike of all muscular movement, of the movement of amœba by pseudopodia and of the movement of cilia, will fall into one general scheme Similarly, the transmission of the nervous impulse is being shown to proceed on essentially the same lines in animals of widely separated groups The essential physiological processes already function in the protista If the physiological processes are few and circumscribed, variations in structure and form will be limited also, recognising that form is "a product of an inner physiological activity" (Kusnetzov D'Arcy Thompson, "Growth and Form", 1917).

The last of the three principal factors on which Darwin based his theory of evolution was natural selection, or in Herbert Spencer's phrase, which Darwin adopted, "the Survival of the Fittest". Later, Ray Lankester suggested another formula, "the elimination of the unfit", which describes more correctly the meaning of the conception. That natural selection, acting on heritable variations, is *a* factor in fixing adaptations is almost a

truism. But whether it is the only factor, whether it is sufficient by itself to account for the living things we know, each fitting so perfectly its own little niche in its world, is a more difficult question The process is of necessity so slow But the time available is enormous, and geologists and physicists seem satisfied that it is to be reckoned in tens, if not in hundreds of millions of years We must consider also whether the mutations that occur are sufficiently diverse, for if adaptations are to be selected, mutations in the direction of those adaptations must occur The known mutations of *Drosophila* amount to some 400, but the mutations so far studied are, for practical reasons, those which are large and obvious. There is increasing reason to think that they are outnumbered by small mutations which only long practice can detect Many mutations studied are slight colour changes, because they can be distinguished with remarkable precision by the practised human eye Correspondingly minute changes in size or shape would be very hard to detect, and to study them by breeding experiments and the methods of Mendelian analysis is not yet possible. We can only form judgments about them by analogy with results from larger mutations There remains the statistical method of attack, by the study of mass-populations of successive generations The method is efficient, active, and advancing, and it can only be lightly disregarded by those who have failed to grasp its meaning

Alternative or additional theories to account for evolution are favoured by many naturalists Darwin himself attached much importance to characters being inherited which had been produced by constant use or disuse in the parent. This is a particular case of Lamarck's conception of "the inheritance of acquired characters", or, better expressed, of somatic modifications Some authorities consider that experimental proof of such inheritance is already available for example, MacBride cites the work of Kammerer and of Durkhen and Brecher, the latter work being supported also by Heslop Harrison. On the other hand, Graham Kerr ("Evolution" London: Macmillan and Co, 1926) advances strong arguments on the other side, and Goodrich ("Living Organisms", 1924) takes the same view · "The real question Biology has to answer in future, as O Hertwig has pointed out, is not 'Are modifications inherited?' but 'How are new factors acquired?'"

Even if it could be proved experimentally, without possibility of question, that somatic modifications were inherited, we should only have advanced a little way towards an understanding of our problem The question *how* the soma influenced the factors in the germ cell would remain. In this connexion Cunningham's suggestion that hormones provided a capable instrument is of interest, and might be followed up experimentally.

The more elusive notions, which introduce the idea of some psychic or psychoid influence, controlling and regulating the processes of metabolism and organic growth, it is hard to distinguish from the animisms of primitive man, who finds a spirit on every mountain, a devil in every bush All these ideas contain a suggestion of purpose, some of them an idea of almost conscious purpose such as we know only in ourselves, or by analogy assume in higher animals, in each case associated with an elaborately differentiated nervous system. They are brought into the story at the point where knowledge based on observation and experiment ceases, at the point where it seems to many of us more satisfactory to say frankly, I do not know.

The idea of orthogenesis or nomogenesis (Berg, 1926), the idea that development takes place in a predetermined direction, is certainly unsatisfying in its elementary form. An explanation of adaptations on these lines offers special difficulty, for the theory fails to provide the flexibility necessary to produce that constant adjustment of the organism to its ever-changing environment which is imperatively demanded If, to reach the required adjustment, a predetermined direction of variations and of evolution is postulated in the organism, a predetermined evolution of the environment on parallel lines would surely be necessary. That evolution proceeds according to laws of the same character as other laws of Nature, is the common basis of all modern evolutionary theory, and was held perhaps more strongly by Darwin, Huxley, and Weismann than it is by some writers of to-day The physical laws in accordance with which the processes of growth are controlled, with results that we see in so many curious patterns, from the simple branching of a tree or of a nerve fibre to the elaborate spirals of a shell or of a growing plant; or again, the laws which lie behind the varied shapes, so curious and wonderful, of organisms and of their different parts,—these laws, and many others like them, still call for serious consideration and research. This is the valuable feature of the theory of orthogenesis, and in directing renewed attention to it, its followers make a valued contribution to biological thought

There are many other aspects of the problem of the origin of adaptations that might be considered, but it has seemed better to confine ourselves to the larger questions, even at the risk of saying nothing but what was already well known The outlook for biology to-day is as alluring and as full of hope as it was in those years of joyful enthusiasm which followed the historic paper by Darwin and Wallace, communicated to the Linnean Society by Hooker in 1858. In whatever direction we look problems bristle, problems open to successful attack; and the old qualities, insight, patience, and determination, will get them solved But we must not limit the outlook, and all aspects of biological research must proceed hand in hand. Botany, zoology, palæontology, the work of the systematist and of the field naturalist, the study of structure and the study of function, the work of the embryologist and of the experimental physiologist, of the geneticist and of the statistician, all are necessary, and none can succeed without the others.

News and Views.

THE President of the Board of Trade has appointed a committee to report whether any, and if so what, amendments in the Patents and Designs Acts, or changes in the practice of the Patent Office, are desirable. This committee may be regarded as the result of the suggestive report on the Reform of the British Patent System, issued by the British Science Guild in October last and reviewed in detail in NATURE of Nov. 17, 1928 (vol 122, p. 757). This report was the work of an expert committee of which Dr W. H. Eccles was chairman and Capt C W Hume, honorary secretary. It immediately aroused the keenest interest throughout the country and even abroad, and was generally considered to be a very valuable document. Nearly thirty professional institutions and organisations representing the industrial and business world appointed committees to consider the report, and a number of these are understood to have endorsed its findings in general terms, with reservations in matters of detail in some cases

As no particular interest, to say the least, was taken in the British Science Guild report by the Board of Trade when it appeared, it is probably not too much to assume that the public attention since given to the report has now, after a lapse of seven months, led the President of the Board to appoint an official committee to consider the same subject The chairman is Sir Charles Sargant, a former Lord Justice of Appeal, and the members are Mr. Horatio Ballantyne, a chartered patent agent and a director of Messrs. Lever Brothers ; Mr. H. A. Gill, a chartered patent agent and member of several previous committees on patent matters, including the international conference of 1925 and the British Science Guild committee ; Mr. E. H. Hodgson, of the Board of Trade , Sir Herbert Jackson ; Mr. W. S Jarratt, Comptroller-General of the Patent Office ; Mr Fearnley Owen, a solicitor ; Mr. J. G Weir, a member of the Glasgow firm of engineers ; and Mr. James Whitehead, of the patent bar, who was chairman of the Dating of Patents Committee, 1927. The secretary is Mr. R. W. Luce, a member of the non-technical staff of the Patent Office. We suggest that the absence of any representative of the electrical industry is to be regretted, since British industry is likely to be profoundly affected by electrical developments during the next decade , but perhaps the officials of the Board of Trade consider that the electrical aspects of the subject are sufficiently represented in the British Science Guild report.

BY means of the Government grant of £100,000, and more than £180,000 collected by the *Times*, a very large sum is now available for the purchase of radium for Great Britain. Prof. F. A. Lindemann, in the *Daily Telegraph* of May 15, raised the question of justification for the present price of radium. The ordinary expectation is that when a chemical product is made the subject of large-scale operations, the price of the product will diminish. With radium the reverse has happened, for when it was produced on a very small scale, the bromide of radium in a high state of purity could be sold, presumably at a profit, for about 32*s*. per milligram of radium element content. Large-scale production was first attempted in America with the low-grade ore carnotite, but the price was always a high one by comparison with that quoted above, and rose during the War to more than £30 per milligram of element Belgian production has brought the price down to £12, but the interests concerned have sold it for £10 per milligram where large quantities have been in question, and, on the other hand, they may charge £14, as stated by an official in a communiqué to the *Daily Telegraph* of May 25 Prof Lindemann's question remains a pertinent one, for whether it would pay to explore British territory for radium obviously depends on whether, with a find so rich as that in the Belgian Congo, production on a big scale would make a really big difference in the present selling price.

THE retirement on May 20 of Mr. W J. Bean from the position of curator marks another milestone passed in the history of the Royal Botanic Gardens, Kew His loss to the establishment will be very great, for, in addition to his extensive knowledge of plants, he possessed considerable administrative ability and had the faculty of inspiring confidence and respect. Mr. Bean comes of Yorkshire stock and entered Kew as a student gardener in April 1883 His personality soon marked him out for advancement, and in 1888 he was given charge of the Temperate House Department. His great opportunity came, however, in 1892, for in that year the late Sir William Thiselton-Dyer began the reorganisation of the arboretum, and Mr Bean was transferred from the Temperate House to take charge of the work. At that time the collections of trees and shrubs were weak in number of species, the general standard of cultivation was low, and really decorative subjects were not shown to advantage. The work over a number of years was very arduous, but all who know the Kew arboretum of the present day will agree that Mr. Bean is well repaid for his many years of hard work During the greater part of his career at Kew, Mr. Bean has contributed to periodical horticultural literature. He is also the author of " The History of the Royal Botanic Gardens, Kew " (Cassell, 1908), but is probably better known for his book " Trees and Shrubs Hardy in the British Isles " (John Murray, 1915), which has already been reprinted four times Mr Bean has for many years been a member of the Floral Committee of the Royal Horticultural Society, and the Society has awarded him the Veitch Memorial Medal and the Victoria Medal of Honour. His services have on many occasions been requisitioned by public bodies at home and abroad, and in 1924 he was appointed a companion of the Imperial Service Order.

THE Davy centenary celebrations at Penzance will take place on June 8, the arrangements having been made by the Royal Geological Society of Cornwall, the Royal Institution of Cornwall, and the Royal

Cornwall Polytechnic Society; the headquarters of which are respectively at Penzance, Truro, and Falmouth. At noon on that day the Mayor of Penzance, accompanied by members of the Town Council and of the three Cornish societies, will proceed to the Davy statue, upon which a wreath will be placed; luncheon will be served at the Pavilion at one o'clock, and at three o'clock a public meeting will be held in the same building, over which the Mayor will preside Addresses will be given by Dr J Symons, president of the Royal Geological Society of Cornwall, Mr J C. Tregarthen, Sir Humphry Davy Rolleston, and Sir Ambrose Fleming, the last of whom will represent the Royal Institution of Great Britain, where for eleven years Davy worked and lectured so successfully. An exhibition of Davy relics will be on view. The Societies will be pleased to welcome anyone interested in the proceedings.

THE seventh Annual Conference of the South-Western Naturalists' Union was held at Torquay during Whitsuntide under the presidency of Dr F. A. Bather The Union covers the counties of Cornwall, Devon, Dorset, Somerset, Gloucestershire, and Wilts The meetings were held in the Pengelly Hall at the Museum of the Torquay Natural History Society, the president of which, Sir Francis Layland-Barratt, received the guests The fine weather favoured excursions to Kent's Cavern, with Mr H. G. Dowie as guide, round Dartmoor, and to the chief points of geological interest in the neighbourhood of Torquay under the vigorous leadership of Mr. G. C. Spence. Sir John Russell delighted the members with an address on "The Conquest of the Waste Places", showing, chiefly by illustrations from the wheat belt of Canada and the irrigation of Australia and Egypt, how science has countered the pessimistic predictions of Sir William Crookes. Mr. F. R Horne, of Seale Hayne Agricultural College, lectured on the succession of various woodland associations by grass land, and Mr J. Walker read a paper on the moths and butterflies of the Torquay district The president's address, "Imagination and Fossils", showed how the controlled imagination can reconstruct the living form, habitat, and mode of life of vanished creatures quite unlike any now existing.

ON May 15 a disastrous explosion, followed by fire, at the Cleveland Clinic, Ohio, was the cause of more than a hundred deaths among patients and staff. The heavy mortality was due to gas poisoning; rescue work was much hampered by the dense brown choking fumes in the building, which, it was suggested, were bromine The first explosion appears to have occurred in the X-ray department, and was probably due to the ignition of cellulose nitrate photographic film stored there. In a statement made to Science Service, of Washington, D C, Dr. Charles E Munroe, the chief explosives chemist of the U S Bureau of Mines, stated that, within less than a half-minute after the explosion of such film, the resulting gases would be about one-third carbon monoxide and one-tenth oxides of nitrogen. These gases, produced in large quantities, spread through the building, and the brown fumes of the oxides of nitrogen were thought to be bromine The secondary explosion was probably due to the ignition of an explosive mixture of the carbon monoxide with air In investigations upon the effects of the fumes from smokeless powder explosions made by H C. Knight and D C. Walton at the Chemical Warfare Service's Edgewood Arsenal in 1925, it was found that experimental animals brought out of the explosion fumes, apparently unharmed, succumbed later to pulmonary œdema Since the fumes from smokeless powder are practically identical with those from cellulose nitrate film, this would account for the delayed poisoning effect shown by many of the victims.

THE Linnean Society of London held its anniversary meeting at Burlington House on May 24, under the presidency of Sir Sidney F. Harmer The following were elected officers of the Society for 1929–30:—*President*: Sir Sidney F. Harmer, *Treasurer*: Mr H. W Monckton, *Zoological Secretary:* Dr. G. P. Bidder, *Botanical Secretary*: Mr. J. Ramsbottom. The Linnean Gold Medal for 1928–29 was handed to Dr. J. B Hubrecht, Counsellor of the Netherland Legation, and son of the famous zoologist, for conveyance to Prof. Hugo de Vries, to whom the medal had been awarded in recognition of his great contributions to the advancement of botanical science In presenting the medal, the president, Sir Sidney Harmer, paid tribute to the influence de Vries has had on biological thought since his thesis in 1870, particularly by his work on osmotic pressure, his theory of intracellular pangenesis, and his long series of studies on experimental evolution.

LIEUT.-COL A. T GAGE, having informed the Council of the Linnean Society of London that he wishes to resign his position as Librarian and Assistant Secretary at the end of October, Mr Spencer Savage has been appointed to succeed him Col Gage was formerly the Director of the Botanical Survey of India and Superintendent of the Royal Botanic Garden, Calcutta He entered the services of the Linnean Society as assistant to the late Dr B. Daydon Jackson in 1924, succeeding him in office (though not with the special title of General Secretary) in 1926 Mr. Savage has been clerk to the Society since 1911, with a break while on active War service He is well known to botanists by his bibliographical studies and to members of the Society as an authority on the Linnean collections and manuscripts.

THE Hanbury Memorial Medal of the Pharmaceutical Society of Great Britain for "high excellence in the prosecution or promotion of original research in the Natural History and Chemistry of Drugs" has been awarded for the year 1929 to Prof. Henry Hurd Rusby, professor of materia medica in the College of Pharmacy, Columbia University, New York The medal is purchased from a fund raised in 1876 to perpetuate the memory of Daniel Hanbury, F.R S, who died in the previous year. His family name is perpetuated by the house of Allen and Hanbury, in which his father, Daniel Bell Hanbury, who survived him, was a partner. His principal investigations were upon

the drugs of commerce of his time In 1927 the recipient of the medal was Dr T A Henry, of the Wellcome Chemical Research Laboratories, an authority upon the chemistry of the drugs, and it is fitting that his successor to the award should be one who has specialised upon their botany and natural history So long ago as 1880, Prof Rusby accompanied an expedition organised by the Smithsonian Institution to New Mexico and Arizona, where many new species of plants were discovered, and in 1885 he was in Bolivia, when some four thousand previously unknown species were found and described It was while exploring Para and Brazil that he discovered the plant *Cocillana*, and first made known the medicinal properties for which it is now largely employed. In addition to his explorations in Venezuela, the rubber forests of the Madeira River, and the forests of the lower Orinoco, during the War he went on an expedition to Columbia in search of quinine-yielding barks Nor did the passage of years blunt his zest for exploration, for in 1922 he was in charge of the Mulford expedition which undertook a biological investigation of tracts of the Amazon basin. In addition to the chair of materia medica, he has the post of pharmacognosist to the Port of New York, and with it the responsibility for the inspection of drug imports, a task calling for ceaseless vigilance in the detection of ingenious adulterations. He is at the moment engaged in a typically vigorous campaign to prevent the importation and use of decaying ergot from Russia. Only twice before has the award gone to America—to J M Maisch in 1893, and to F. B. Power in 1913.

AT the present time there is a great demand for underground cables suitable for carrying electric currents at very high voltages in towns and their neighbourhood A very large amount of experimental work in this direction has been carried out by cable manufacturers during recent years. We learn from a paper by G. Martinez which appears in the *Electrical Review* for May 24, that success is now almost assured by the invention of an 'oil-filled' cable. In this cable there is inside the conductor a longitudinal duct carrying oil which is connected with reservoirs at the junctions at each end of a section When the conductors get hot the oil is forced by their thermal expansion into the reservoirs, and when they get cool it is sucked back The conductor is insulated in the usual way, but owing to the diminished mechanical stresses on it the thickness of the insulation necessary is appreciably diminished. The cable is armoured with hard brass strip over the lead sheath and is finally protected with waterproof cloth tape. The working temperature of this oil-filled cable can be much higher than that of the ordinary high voltage cable, and so it can carry a heavier load, while it can be safely laid directly in the ground. There are no hollows inside these cables In ordinary cables the brush discharges that take place in a hollow are a frequent cause of breakdown. It is claimed that it is possible to install underground cables of this new type up to pressures of 220 kilovolts We understand that two 132 kilovolt lines having a total length of 52 miles will be installed in London very shortly. The installation is partly experimental, but the makers have so much faith in the performance of their cables that they are taking the greater part of the financial risk.

IT is expected that in a few weeks' time the Brookmans Park Station, the first high power station of the regional scheme of broadcasting in Great Britain, will begin operation At first it will radiate only one programme, but later on it is intended to radiate two simultaneously, using different wave-lengths It is probable that at first difficulties will be experienced by listeners, especially those who are in the neighbourhood of Brookmans Park The foreign station listener in this district will have great difficulty in tuning out the local station The ordinary listener also may be unable to hear the programme from 5GB to which he has been accustomed The *Wireless World* for May 15 questions the wisdom of the policy of providing satisfactory crystal reception throughout Great Britain. It suggests that this is probably being done at the expense of those who have invested in expensive valve sets. These listeners have begun to think that they have a right to regard the continental stations as a source of entertainment, however superior the quality of the home reception may be. In the same paper there is an article on "Getting ready for Brookmans Park", describing methods of improving selectivity It is known theoretically that the selectivity of a receiving set can be improved either by diminishing the resistance of its tuned circuits or by increasing their number. In the latter case a filtering effect is imposed on the incoming signals It is found in practice that the limit to which the resistance can be diminished is quickly reached We may increase the number of tuned circuits so as to filter out undesired signals, but this would be expensive. The most promising device is to use a tuned and variably-coupled aerial transformer It is stated that in no other way can the selectivity of a set be so radically improved.

EXTENSIONS of the building of the Royal Scottish Museum, Edinburgh, have permitted considerable expansion and rearrangement of the collections, while the Interim Report of the Royal Commission on National Museums, by allaying the fear of fire, permitted the progress of equipment and schemes previously held up. Thus we read in the Director's type-written Report for 1928 of the opening of a gallery of comparative ethnography, two new halls for natural history, a civil engineering gallery, and added exhibition space for minerals. A beasts of prey hall and an architectural hall will be opened before long. Still there are complaints of lack of space · a printing press bought for exhibition has to be kept in store, while the consultation of reserve collections is hampered for want of storage accommodation. For all that, the collections grow: the larger accessions include the Logan collection of British Lepidoptera , the late Robert Dunlop's fossils on loan from Dunfermline will be more accessible to students , a most useful collection of ceramics is lent by Lady Binning. Among the numerous individual additions one notes the first specimen of the desert

wheatear to be found in the British Isles, the nest of a garganey duck—the first proof of its nesting in Scotland—and a self-rescue apparatus presented by the Mine Safety Appliances Co of Pittsburg One learns without surprise that the museum grows in popularity. Apart from the school classes and the lantern lectures to school children, the annual number of visitors has increased by 130,000 within the last eight years. It is believed that visitors to the city are responsible for the numbers on week-days, but that local people make up the large Sunday crowds Evening opening, so often clamoured for, appears here, as elsewhere, scarcely to warrant the additional cost of lighting and attendance

THE floating of globules of mercury on a water surface was described recently in letters to the Editor (Mar. 16 and May 18) A correspondent reminds us that this effect was dealt with by Prof C V. Boys in the second edition of his well-known book on "Soap-Bubbles and the Forces which Mould them" The description is as follows "One of the most beautiful bubbles of one liquid in another which can be produced is occasionally formed by accident If a basin of water containing a few pounds of mercury is placed under a violently running water-tap the water and air carried down into the mercury cause mercury bubbles to form and float to the surface. I have been able to float these into a second basin, where sometimes for a few seconds they look like shining balls of pure silver, perfect in form and polish When they break, a tiny globule of mercury alone remains, far more, however, than the liquid of a soap-bubble of the same size. I have obtained mercury bubbles up to about ⅝ inch in diameter M Melsens, who first described these in 1845, found the upper part to be so thin as to be transparent and of a slaty-blue colour, a phenomenon which I have not noticed"

THE code devised at Strasbourg and adopted by international agreement for the telegraphic transmission of seismological information provides only for the data derived from the seismograms of individual stations (NATURE, Dec. 22, 1928, p. 968) There are occasions, however, when the sender of a report has already determined the epicentre of an earthquake and wishes to give its position. For this purpose, a simple method has been adopted by the Meteorological Office and by the U S. Coast and Geodetic Survey At the close of the report there will be added the word 'epicentre' and a group of five figures The first two figures give the latitude and the last three the longitude. If the latitude is north and the longitude east, the number 2 is added to the middle figure, if south and east the number 4, if south and west the number 6, and if north and west the number 8. Thus, the figures 01779 would indicate that the epicentre is in lat. 1° S, long. 179° W.

IN the January issue of the *Bulletin de la Société d'Encouragement pour l'Industrie nationale,* the Agricultural Committee of the society gives an account of the steps which have been taken during the past twenty years by the railway companies of France to encourage agriculture and the remarkable results obtained. The Paris-Orleans company in 1903 began to distribute pamphlets, to organise lectures, discussions, and demonstrations, with the view of improving and intensifying production and increasing the possible markets for fruit, cereals, potatoes, wines, cattle, milk, butter, cheese, fowls, eggs, and honey Special officials were appointed to deal with the rapid transport of this produce to market The result of these efforts was remarkable in 1905 the company carried 250,000 tons of agricultural produce, and in 1907, 639,000 tons. Other French lines have taken similar action with like noteworthy results

DR J H QUASTEL, of Trinity College, Cambridge, who is known for his work on reduction-oxidation systems and for his studies of the activation of molecules by living organisms, has been appointed biochemist at the Cardiff City Mental Hospital.

A VIOLENT earthquake was recorded at Kew Observatory, commencing at 22 hr 51 min. 19 sec. G M T, on May 26. The epicentre is estimated to have been 4800 miles away, but the initial impulse was not sharp enough to give any indication of the bearing

AT the annual general meeting of the Institute of Physics, held on May 28, the following were elected to take office on Oct 1 next :—*President :* Dr. W. H. Eccles, *Honorary Treasurer :* Major C. E S Phillips; *Honorary Secretary* Prof. A O. Rankine Sir Ambrose Fleming, Sir James Jeans, and Sir Oliver Lodge were elected honorary fellows of the Institute.

IT is announced in *Science* that the Agassiz medal for oceanography of the National Academy of Sciences of the United States has been awarded to Prof. J. Stanley Gardiner, professor of zoology and comparative anatomy in the University of Cambridge, and the Watson medal to Dr Willem de Sitter, director of the Observatory at Leyden and professor of theoretical astronomy in the University.

THE fourteenth Annual Conference of the Museums Association will be held at Worthing on July 1–5, under the presidency of Sir Henry Miers. The presidential address, on "Co-operation—the Association's Task", will be delivered on July 2, and will be open to discussion In connexion with the Conference there will be an exhibition of museum furniture and requirements. The local secretary for the meeting is Miss Marian Frost, The Museum, Worthing.

THE Rochdale Literary and Scientific Society has celebrated the jubilee of its formation by the publication of a volume of *Transactions* covering the years 1926–28, and by the presentation of his portrait to Dr. J. R. Ashworth, in recognition of his services as honorary secretary since 1885. Dr. Ashworth contributes a short article on "The Influence of Rain on Atmospheric Deposits", and an unusual and well-illustrated account of the very varied structure of the old pack-horse tracks about Rochdale is given by Jas. L. Maxim.

THE Council of the Association of British Chemical Manufacturers has decided to prepare and issue to its members a set of model safety rules for use in chemical

works. The Works Technical Committee has been actively engaged for some months on the preparation of these rules, and a small booklet of provisional rules has now been presented to members of the Association. A set of explanations of these rules is in preparation by the Association, the address of which is 166 Piccadilly, London, W.1.

Applications are invited for the following appointments, on or before the dates mentioned :—A lecturer in the Electrical Engineering Department of the Sunderland Technical College—The Chief Education Officer, 15 John Street, Sunderland (June 5). Assistant Examiners in the Patent Office—The Secretary, Civil Service Commission, Burlington Gardens, W 1 (June 6). A principal engineering inspector under the Engineering Inspectorate of the Electricity Commission—The Secretary, Electricity Commission, Savoy Court, Strand, W.C 2 (June 8) Lecturers in, respectively, engineering, chemistry, and physics, and a mechanical workshop instructor and an electrical instructor, each at the Constantine Technical College, Middlesbrough—The Director of Education, Education Offices, Middlesbrough (June 10). An assistant lecturer in Nature study and horticulture at Stranmills Training College, Belfast—The Principal, Stranmills Training College, Queen's University, Belfast (June 10). A principal of the Government Commercial Institute, Calcutta—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (June 12). An assistant lecturer in the Mathematical Department of the Derby Technical College—The Secretary, Education Committee, Becket Street, Derby (June 14). A director for the Harcourt Butler Institute of Public Health, Rangoon—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S W.1 (June 15) A scientific assistant under the Imperial Bureau of Soil Science—The Director, Imperial Bureau of Soil Science, Rothamsted Experimental Station, Harpenden (June 19). An assistant lecturer in mathematics in the University of Sheffield—The Registrar, The University, Sheffield (June 19). A bacteriologist at the Antitoxin Establishment of the Metropolitan Asylums Board, Sutton—The Clerk, Metropolitan Asylums Board, Victoria Embankment, E C.4 (June 19). A senior plant introduction officer, an assistant plant introduction officer, an assistant plant pathologist, a weeds officer, an assistant mycologist, an assistant plant geneticist, and two assistant agrostologists under the Commonwealth of Australia Council for Scientific and Industrial Research —F. L McDougal, Australia House, Strand, W.C.2 (June 20). An assistant Government analyst, Hong Kong—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (June 30). A research assistant in dyeing in the University of Leeds—The Registrar, The University, Leeds (July 1). A zoologist on the scientific staff of the *Discovery* Committee—The Secretary, *Discovery* Committee, Colonial Office, S.W.1 (July 15). A senior secretary on the central administrative staff of London University—The Principal, University of London, South Kensington, S.W.7. A lecturer in library routine and practical cataloguing in the School of Librarianship, London University—The Secretary, University College, Gower Street, W.C.1. A laboratory steward in the physics department of the University College of Hull—The Secretary, University College, Hull.

Our Astronomical Column.

The Total Solar Eclipse of May 9.—*Harvard Announcement Card*, No 87, announces that Prof. H. T. Stetson, who was stationed at Alor Star, Kedah, experienced some interference from high cirrus clouds, but succeeded in measuring the illumination of the corona. He found it equal to 0 15 candle at 1 foot, or to 1 candle at 2 58 feet. As the brightness of the sun has been given as equal to 5000 candles at 1 foot, it is about 33,000 times as bright as the corona.

A Double Star of the Type of Gamma Virginis —Mr C. Luplau Janssen discusses the orbit of the star Burnham 12304 in *Mon Not. Roy. Ast. Soc.* for March. He shows that the distance, which increased from the discovery of the duplicity in 1832 up to 1910, is now decreasing, and that an approximate orbit can now be deduced. That which he gives is of the type of Gamma Virginis with very large eccentricity (0·95) and very close approach at periastron, which he calculates will take place in 1976. The period is 177·2 years, and the semi-major axis 2·81″. The hypothetical parallax is 0·089″. It is important to follow the star carefully during the approach to periastron.

Historical Records of Meteoric Showers.—Prof. W. J. Fisher, of Harvard College Observatory, Cambridge, Mass., has issued a circular, and distributed it amongst astronomical and other scientific institutions, asking for old accounts of abundant meteoric displays. He intimates that though many descriptions were found by Newton, Quetelet, Herrick, and others, there must be numbers of additional records which have never yet been brought into the light and suitably investigated That this may be accomplished, and that a thorough discussion of all the available results, ancient and modern, may be submitted to examination and deductions made, seem desirable. It is therefore hoped that persons having access to ancient works containing accounts of long past meteoric exhibitions will search them out and send copies of them to the Harvard Observatory so that they may receive due consideration.

With new data gleaned from old catalogues and chronicles, and the whole comprehensively treated, there is no doubt that our knowledge might receive important additions of interesting kind. From Russian and Japanese sources some useful details have already been received, and the research promises good results if the subject is amply worked up and supported as it undoubtedly deserves

Of the display of Leonids in November 1766 nothing is apparently known more than mere rumours can convey. Dr Dick says the meteors of 1799 were seen by all the inhabitants of Cumana, the oldest of whom asserted that the great earthquakes of 1766 were preceded by similar phenomena. Further careful inquiry might elicit important details.

Research Items.

FOOD OF THE GREAT HORNED OWL.—A short account of the more striking habits of this owl (*Bubo virginianus*) appears in the *Canadian Field-Naturalist* for April. In the poplar savanna of Manitoba, where the author, Ralph D. Bird, studied the owl, he estimated that one nesting pair was present in every square mile of suitably wooded country, the presence of good hunting grounds being apparently a decisive factor in the selection of the site. The birds when disturbed have been known to attack man, and the author describes a concerted attack upon himself which had serious enough consequences. An examination of 112 food pellets showed that as a staple diet rabbits headed the list, then followed voles, pocket gophers, ground squirrels, and occasional birds, taken especially after the spring migration. The association of prairie and woodland mammals in the diet suggests a wide hunting range on the part of the owl. Although the nests were not far from farmyards, only one domestic fowl was found to have been taken, and game birds did not average as many as two per nest. The conclusion is that the bird is a decided benefactor to humanity, through its enormous destruction of rodents, which injure crops and are second only to fire as a factor in checking the spread of the forests.

THE GENUS *PHELLIA*.—Dr. T. A. Stephenson's account (*Trans. R. Soc. Edin.*, vol. 56, 1929) of the British species of *Phellia* fills a lacuna in our knowledge of British sea-anemones. In 1858 P. H. Gosse collected from a "rock called Proudfoot, at the entrance to Wick Bay in Caithness", the original specimens of *Phellia gausapata*. The author visited this rock in 1926, and collected thirteen examples of the species, and has given an account of their external characters and internal anatomy. He has examined three other species which have been regarded as belonging to the genus *Phellia*, and shows that two of them —*P. murocincta* and *P. picta*—are Sagartias, and that the other—*P. brodricii*—should be placed in a new genus, *Cataphellia*. The genus *Phellia* is defined for the first time on a valid basis and its relationships determined; it is removed from the Sagartiidæ and placed in a separate family, the Phelliidæ—with *P. gausapata* as the type species. The patterns developed on the disc and tentacles in the Phellias and other sea-anemones are analysed, and their value as an indication of relationship discussed, especially in respect of species the relationships of which are difficult to determine. The paper is illustrated by text figures and by finely executed drawings in colour which have been admirably reproduced.

GENETICS OF *PRIMULA KEWENSIS*.—In 1899, *Primula Kewensis* appeared at Kew as a natural hybrid between *P. floribunda* and *P. verticillata*. The cross was then successfully made, but has never been repeated, the few plants obtained in later attempts being either like the mother (*floribunda*) or tetraploid *Kewensis*. The original diploid hybrid plants first bore seeds in 1905, producing the tetraploid form. Owing to errors in the early work on this form, it has long been a cytological and genetical misfit. In a paper by the late W. C. F. Newton and Miss C. Pellew (*Jour. of Genetics*, vol. 20, No. 3), which will become a classic, the various problems regarding its origin and genetical nature are solved, and it is brought into line with other cases in recent genetical literature. The fertile *P. Kewensis* is shown to be a tetraploid mutation arising in somatic tissue of the sterile diploid hybrid, and not due to a transverse fragmentation of the chromosomes as formerly supposed. Usually the diploid hybrid is highly sterile, but on the three occasions in which it is known to have set seeds, these gave rise to fertile tetraploid plants. The third lot of such plants, grown at Merton, was the largest, numbering 287 plants, of which 261 were of the ordinary tetraploid type, while the remaining 26 showed much variation, which was generally associated with the presence of 35 or 37 instead of 36 chromosomes. There is also variation in mealiness and shape of the leaves. Several other cases are now known in which a tetraploid form is produced in the crossing of two diploid species, but *P. Kewensis* differs from these in that the tetraploid condition first arises in somatic tissues. By crossing it with the diploid parents, various triploid or near-triploid forms have been obtained and studied. This paper is an excellent example of the necessity for cytological studies in the investigation of any complicated genetical situation, but various problems regarding the descendants of *P. Kewensis* remain to be attacked.

SODIUM ACCUMULATION AND THE EARTH'S AGE.—In the *Am. Jour. Sci.* for April 1929, Prof. A. C. Lane directs attention to yet another source of error in this much-discussed method of estimating geological time. It has been customary, in estimating solvent denudation, to take several analyses of the river water and average them to get the average composition, and then multiply this by the total run-off. This neglects the fact that, generally speaking, the greater part of the run-off of a river is in floods, and that in time of flood the amount of sediment is greater, and of dissolved matter much less, than when the river is normal or low. From work by W. D. Collins on the Colorado River, and by L. Nys on the Meuse and the Ourthe, Lane deduces that it would not be safe to take the solvent denudation of the lands by river waters at more than five-eighths of that usually adopted (for example, by F. W. Clarke in his well-known "Data of Geochemistry"), and he thinks there is a fair possibility that it may be no more than two-fifths. Making allowance for other factors, and for the slow denudation of small continents in times of peneplanation and marine transgression, it is not difficult to bring the figures for the age of the earth by solvent denudation into agreement with the longer periods obtained from the lead-ratios of radioactive minerals.

LIMESTONES AND LIMESTONE SOILS OF THE EAST INDIAN ARCHIPELAGO.—In *Communication* No. 14 of the Geological Institute of the Agricultural University of Wageningen, Holland, Prof. J. van Baren has presented in English the results of his investigations during the last thirteen years on the weathering of limestones and the formation of limestone soils in Java and other islands of the Dutch East Indies. Detailed qualitative mineralogical analyses are given for 21 rocks and for two mechanical fractions of 46 soils derived from them. Other soil data include colour by Lovibond's tintometer, mechanical analysis, hygroscopic coefficient, maximum water capacity, and reaction measurements by several methods. Full chemical analyses are given for a dozen soils and their underlying rocks. It is concluded that the properties of the soils are determined primarily by the composition of the limestone rock. Although the rainfall is important the present knowledge of agricultural climatology is totally inadequate as a basis for the classification of soils and soil-forming processes. The analogies that have been drawn between the red limestone soils of the tropics and other red soils,

such as the Mediterranean *terra rossa*, are strongly criticised. The red colour shows nothing beyond the presence of some colloidal iron oxide of unknown origin and gives no evidence that the soil has been formed in a humid tropical climate. It is claimed that the careful collection of facts must proceed for many decades before generalisations on the relation of soil to climate can have any value Prof van Baren appeals especially for detailed and systematic mineralogical research on the relation of the soil to the parent rock He has been able to distinguish minerals formed within the soil from those derived from the parent rock or introduced by the action of volcanoes, water, or wind The fuller study of such newly formed minerals should reveal some of the chemical processes within the soil. Again, it is shown that apatite is rarely present in either soils or rocks, and cannot be the source of the phosphoric acid in these soils. Prof van Baren's detailed notes, photomicrographs, and bibliographies on the minerals and organic remains identified will prove of great value in extending this type of work

REFRIGERATION CONSTANTS —Supplement No. 65 to *Communications* from the Physical Laboratory of the University of Leyden contains reprints of the papers communicated by Drs. Keesom and De Haas to the Institut International du Froid on the entropy-temperature and total heat-entropy diagrams of methane, ethylene, nitrogen, hydrogen, and helium The whole of the experimental facts available have been used in constructing the diagrams and have been supplemented where necessary by thermodynamic relations and the law of corresponding states Copies of these diagrams may be obtained by those interested in refrigeration through the Institut International du Froid

DIFFRACTION OF LIGHT.—The April number of the *Physical Review* contains a paper by Profs M. E Hufford and H. T Davis which is illustrated by a very beautiful pair of photographs of diffraction patterns. These were produced by passing monochromatic light from a small source through two circular holes, and the one from the smaller aperture shows some seventy clear concentric rings in the original The radii of these have been measured up carefully, and have been compared with the radii computed by an extension of the classical wave theory of diffraction by a circular aperture which was given by Lommel, calculated and observed values are in good agreement As the authors point out, an investigation of this nature would have been considered to be of purely academic interest a few years ago, whereas at the present time it is of considerable value in defining the regions in which wave theory and quantum theory are individually applicable It is to be regretted that the detail of the photographs, exceptionally good as it is, is insufficient to show the presence of some secondary fringes that should theoretically be present.

BRIDGE STRESSES.—The issue of the *Journal of the Royal Society of Arts* for May 3 contains the Trueman Wood lecture delivered by Sir J. Alfred Ewing on the results of the work done during the past six years by the Bridge Stress Committee of the Department of Scientific and Industrial Research. It has been found that the passage of a locomotive over a bridge produces a deflection at the centre which oscillates between limits determined by the weight of the locomotive and the intensity of the hammer blow it strikes on the rails due to the movement of unbalanced parts of its mechanism Some of the lighter engines still in use weighing 15 tons per axle deliver a blow equivalent to a further 15 tons, when some of the more modern ones weighing 20 tons per axle only deliver a blow equivalent to a further 5 tons. The subject is too complex to allow simple rules for the calculation of the stresses produced to be formulated.

ARTIFICIAL VERSUS NATURAL ILLUMINATION —In a paper on the cost of lighting industrial buildings which appears in the *Journal of the Franklin Institute* for February, L. L Holladay discusses some of the problems which arise when the electric light can be purchased at a price not exceeding about 0 7 of a penny. In several cases he proves that artificial light is more desirable than daylight from the economical point of view It is pointed out that natural light, whilst costing nothing out of doors, can only be delivered at a certain definite cost indoors The cost and maintenance of the windows and the lighting shafts has to be taken into account In the winter time the thermal losses through the windows are appreciable and increase the heating costs In making the comparison between the running and overhead costs of a building built for artificial lighting and one built for utilising the daylight also when possible, it is assumed that both buildings have similar ventilating and heating apparatus It is assumed that for seven months of the year the inside of the building is maintained at 65° F. and that the air is completely changed twice every hour. The costs of washing the windows at least twice every year and cleaning the lamps at least six times are taken into account The heat loss due to the windows is generally offset by the saving they effect on the cost of the electric light. The author recommends, therefore, that industrial buildings should be built with simple side windows. A windowless building requires a shaft about two feet wide for ventilation It is not economical to incur heavy expenses for lighting shafts or windows in the roof For dwelling houses we must have windows to enable us to see outside, but in factories the glass of the windows is often obscured. The conclusion is that when artificial illumination can be obtained very cheaply, it would be well for the architect to take this into account when designing the building.

THE TESTING OF PORCELAIN INSULATORS.—The initial and maintenance costs of the large number of porcelain insulators required for high-tension overhead distributing systems have made it necessary to apply rigorous tests to them before they leave the factory. They are usually tested in accordance with the standard specification or with one which follows it very closely in essential details. Specifications based on the individual opinions of consulting engineers are now very rare. In a paper read to the Institution of Electrical Engineers on April 11, B. L. Goodlet discussed the technique of porcelain insulator testing. The three basic electrical tests are the dry and the wet spark-over voltage and the puncture voltage. The fundamental mechanical and physical tests are for mechanical strength, ability to withstand a temperature cycle, and the test for porosity. In addition, seven other tests, including corona tests, fog tests, and tests to determine 'fatigue' under vibration, are sometimes specified The six fundamental tests are generally considered to be sufficient. If the physical laws which govern the effects produced were better known, it is highly probable that the required tests could be much simplified and appreciable economies effected The influence of the atmospheric humidity on the spark-over tests is known to few physicists. Curiously enough, an increase in the humidity of the atmosphere up to about 75 per cent, at 40° C., increases the voltage at which a flash occurs. The wet

spark-over voltage test is made with artificial rain. As the rate of precipitation is increased, the spark-over voltage falls rapidly until a rainfall of about 3 mm per minute is reached, after which a further increase in the intensity of the rainfall has little effect on the voltage at which spark-over occurs. The angle of the rainfall has a considerable effect on the result, and so also has the resistivity of the rain, which is a very variable quantity. It is found that fog troubles only occur in districts where a considerable amount of solid matter in a finely divided state is suspended in the atmosphere.

RADIO RECEPTION IN A TUNNEL.—Some interesting experiments were recently made by Dr. A. S. Eve, of McGill University, and several well-known radio engineers, on reception in a tunnel on the Canadian Pacific Railway. The results are printed in the *Proceedings of the Institute of Radio Engineers* for February. The tunnel is $3\frac{1}{2}$ miles long and passes through Mount Royal near Montreal. Preliminary experiments made in 1926 indicated that the penetration of radio waves into the tunnel was a function of their frequency. If the wave-length was less than 100 metres, the radio waves died away within a few hundred feet of the mouth of the tunnel. More exact experiments made in 1928 bring out the fact that the wires, cables, and rails leading into the tunnel play an important part in the reception by the receiving set. The mouths of the tunnel were blocked and the cables were earthed. The results showed that the effect of the cables and rails was also a function of the frequency. The experiments show that more energy enters through the tunnel mouth than was at first suspected. The effects of the rails and cables were due to a variety of causes which involve wave-antenna effects and re-radiation. Curves are given showing graphically the results obtained and details are given of the geology of the region. Amongst the conclusions arrived at are that short waves do not penetrate rock or soil to any appreciable extent, that cables and rails conduct long waves better than short waves, that insulated wires and cables act as wave antennæ, and that a very appreciable amount of energy enters through the tunnel mouth. Further work is required in a tunnel with no wires or rails leading into it.

PULVERISED FUEL IN POWER STATIONS.—In a paper read to the Institution of Electrical Engineers on April 18, Mr. R. A. Chattock discussed the use of pulverised fuel in electric power stations. He claims that, as the result of the experimental work carried out during the last few years at the Birmingham electrical power station, it has been proved that the use of pulverised fuel gives a higher combustion heat efficiency in the boilers than is obtained by mechanical stokers. He points out that for pulverised fuel equipment the capital cost is greater than for mechanical stokers, but, as boilers can be used of far greater capacity than those equipped at present with mechanical stokers, there is a considerable economy effected in the cost of boilers and boiler house. In the second series of tests made at Birmingham, the equipment consisted of four large coal driers of the rotary type which were fired by small furnaces. These driers reduce the total moisture in the coal from 20 per cent to 6 per cent without driving off any material part of the volatiles contained in the coal. The dry coal was conveyed by elevators and conveyors to bunkers in the boiler house. From thence it was fed to four large motor-driven mills each capable of pulverising 12 tons per hour. The mills are air-swept and the fuel is caught in cyclone collectors and stored in bins over the boiler. From these bins it is delivered by special feeders to the six burners installed in each boiler furnace. Two of these boilers have been in operation for a year with a combustion heat efficiency of about 85 per cent. These experiments have led the Birmingham Corporation to adopt boiler units having an evaporative efficiency of 200,000 lb. of water per hour for the new Hams Hall Station. Unit pulverisers will be used for the boilers, each of which will have five mills, four to run and one to be kept in reserve. New developments are in progress, but satisfactory results extending over several years have been obtained both in America and on the Continent.

PREPARATION OF SUBSTITUTED DIPHENYLAMINES.—The preparation of substituted diphenylamines is often a matter of some difficulty, and it is therefore interesting to note that a new method is given by A. W. Chapman in the *Journal of the Chemical Society* for March. As previously shown, *N*-arylaryliminoaryl ethers [R.C (OR″). NR′] are converted quantitatively by the action of heat into acyl derivatives of the corresponding diphenylamines [R.CO.NR′R″], and on treatment with alcoholic potash these acyl compounds are readily hydrolysed to the corresponding diphenylamines in yields of about 80 per cent.

SOLUBILITY OF IODINE IN SOLUTIONS OF HALIDES.—The *Journal of the Chemical Society* for March contains an account of experiments carried out by Carter and Hoskins which appear to show that the solubility of iodine in solutions of halides is the result of a tendency to form polyhalides and the opposing salting-out effect. The latter effect is considerable with bromides and chlorides, but negligible with iodides and with the halogen acids. Attention is directed to the fact that in their investigation of the tri-iodide equilibrium Bronsted and Pedersen used potassium chloride solution as solvent and assumed that all the dissolved iodine was present in the free state. No allowance was made for the effect of polyhalide formation, and hence the mass-law expression deduced by Bronsted and Pedersen is incorrect. The corrected value for the equilibrium constant in this case is approximately the same as when the solvent is water.

BENZENE RING.—The April number of the *Proceedings of the Royal Society* contains a full account of Dr. Kathleen Lonsdale's investigation of the crystal structure of hexamethylbenzene, $C_6(CH_3)_6$, which, as was indicated in a letter from her to NATURE on the same subject (Nov. 24, 1928, p. 810), is of great interest from the way in which it confirms current ideas of the structure of the benzene ring. This particular molecule, unlike many other aromatic compounds, exists as a separate entity in the crystal, which is triclinic and easily deformed. The X-ray evidence is definite that the molecule is in the form of a ring, and that its nucleus is similar, both in size and shape, to the six-carbon ring of graphite. The X-ray measurements also show that the carbon atom of the methyl group lies in the plane of the benzene ring, so that at least three of the valencies of the aromatic carbon atom must be coplanar. There is unfortunately no new information to be had concerning the elusive fourth bond, except that it must be disposed so as to give the ring as a whole a centre of symmetry, which seems to rule out Kekulé's static model, with its three double bonds. The carbon atoms in the methyl groups, as would be expected from their aliphatic nature, resemble the carbon atoms in diamond rather than those in graphite; the methyl group itself, to use Dr. Lonsdale's analogy, acts towards X-rays very like an electron shuttlecock, if we picture a single atom as a tennis ball.

In the Yellowstone with Princeton.[1]

By Prof. O. T JONES, University of Manchester

IN the issue of NATURE of Nov. 5, 1927, Mr. E. B. Bailey gave a brief account of the 'Summer School of Geology and Natural Resources', which has been organised by Prof R. M Field, of the University of Princeton, N.J I was privileged last summer to be the guest of the Summer School in a tour through some of the characteristic regions of the United States, my fellow guests being Mr. W J Johnston, of the Canadian Geological Survey, and Prof W A Parks, of Toronto

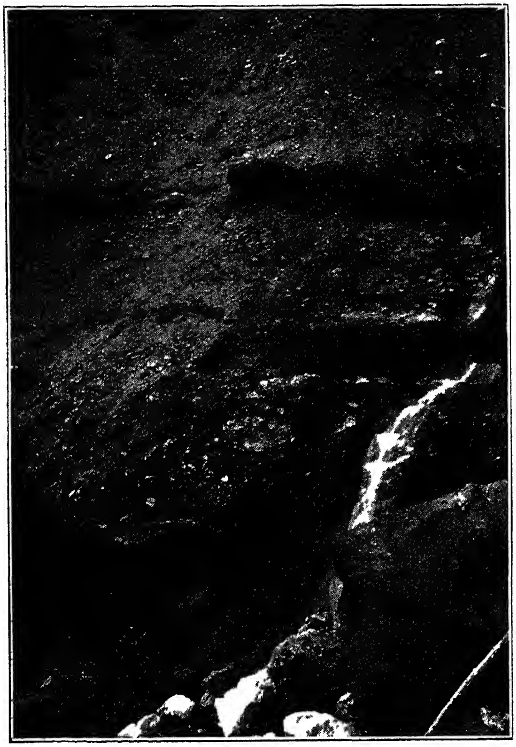

FIG 1 —Section of lower part of sediments near Red Rock Photograph by Prof O T Jones

We started from Princeton on June 21, and returned on Aug 2, and in the course of the tour we visited the Yellowstone National Park.

Within its area of 3344 square miles, this Park numbers many remarkable features, and among them the great canyon which has been carved by the Yellowstone River on its way to join the Missouri is one of the most interesting. After leaving Yellowstone Lake the river winds through a flat-floored valley before plunging in succession over the Upper Fall (108 ft) and the Lower Fall (309 ft), where the canyon commences. About 20 miles lower down, the Yellowstone is joined by the Lamar, an important tributary flowing in a wide, flat-floored valley.

In the course of the 1926 excursion, Prof Field observed from near Artist's Point some sediments in the opposite wall of the canyon about half a mile below the Great Fall, and with a kinematograph camera and telephoto lens obtained a clear record of these deposits In August 1928 we visited the locality and examined the sections in detail Our examination led to the discoveries in regard to the remarkable history of the canyon which are briefly summarised below.[2]

The sediments which Prof Field had previously observed lie in a narrow 'in and out' channel which passes behind a prominent pinnacle on the canyon wall known as the Red Rock, and consist of more than 187 feet of alternations of blue muddy silt, yellow sand, and conglomerate, the coarser deposits having a calcareous or tufaceous cement (Fig. 1) The base of the channel lies about half-way down the canyon wall, which at this point is about 800 feet high Dr Elwyn Perry and other members of the Summer School observed also a small thickness of sediments within 50 ft of the bottom of the canyon and within about 100 yards from the foot of the Great Fall, and one of us noticed on the west side of the canyon, where it is drenched by the spray of the fall, a patch of blue stratified material which appeared to be similar to the silt near the Red Rock On our return to the east we discovered that this exposure had been visited nearly sixty years ago by Dr. A. C Peale, during the preliminary survey of the Park by F. V Hayden and his assistants Dr. Peale described this material as a blue mud, and there is little doubt that this and the sediments low down on the opposite side of the canyon are relics of the same series as that more fully preserved near the Red Rock. We found, too, that the east wall of the canyon, between the Upper and the Lower Fall, is composed in large part of cross-bedded sands capped by a tough conglomerate with tufaceous cement.

According to the prevalent opinion, the canyon was eroded in postglacial times, and it has been regarded as evidence of the enormous amount of denudation that has taken place since the Glacial Epoch. Colour was lent to this view by the distribution of the terraces which surround the Yellowstone Lake and extend down into the Hayden Valley towards the Yellowstone Falls. These terraces are composed in part of resorted glacial deposits which occur around the Yellowstone Lake and in the Hayden Valley, and are therefore clearly of postglacial date It appears also that the conglomerate between the Upper and Lower Falls has been interpreted as an extension of these terrace deposits, and it was so regarded by E. De Martonne, who figured the section in the *Annales de Geographie* (vol 22, 1913, Pl II B, facing p 136). This was also the interpretation adopted by Mr. W. H. Holmes in his report on the geology of the Park attached to Hayden's 12th Annual Report on the Territories, 1878 As this conglomerate occurs on both sides of the present canyon, it was argued that the canyon must be of later date than the Yellowstone Lake terraces, and therefore postglacial Our examination disclosed, however, that a pre-existing canyon had been at some period filled to the brim with sediments, and the relation of these to the glacial deposits seemed to indicate that not only the erosion of the canyon but also its subsequent filling had taken place before the advent of the glacial period, and that the canyon was a much older feature than had been previously supposed.

The fine muddy silts which form a considerable proportion of the sedimentary succession in the canyon recall lake deposits, and the occurrence of several

[1] Based on a lecture entitled "The History of the Yellowstone Cañon (Yellowstone National Park), U S A ", delivered before the Geological Society of London on Jan 9

[2] A more detailed account appears in the *Amer Jour. of Science*, March 1929

layers of silt following immediately upon conglomerate inevitably suggests the establishment of lakes in the canyon at successively higher levels, and their subsequent filling with deposits, beginning with fine sediments and ending up with coarse sands and gravels. Such lakes could only come into existence if the canyon

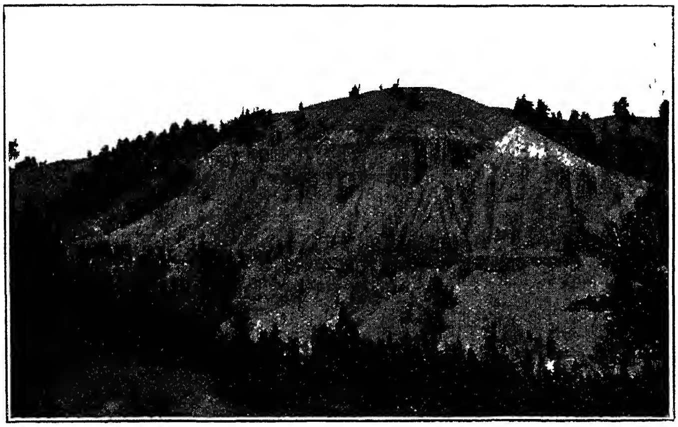

FIG 2.—Section near Tower Falls showing two basalts with intervening conglomerate resting on andesitic breccias. Photograph by Dr M B Hodge

had been dammed below this point subsequent to its erosion What then was the agent which impounded these lakes in the canyon ? The study of the geological maps in the United States Folio (1896) suggested the possibility that great flows of lava had entered the Yellowstone Valley from the north from the direction of Gardiner, and had flowed against the direction of the drainage into the Lamar Valley and the canyon. On the geological map of the Canyon and Gallatin Sheets several small masses of basalt and trachytic rhyolites have been mapped, the relation of which to the flanks of the valley suggests that they are relics of flows which must originally have been of wide extent and filled the lower Yellowstone Valley to a depth of more than 1500 ft

The suggestion that arises naturally from the study of the geological map is, however, contrary to the interpretation of certain of these flows which is embodied in the description of the Folio which was published in 1896. The summary in the Folio of the geological and volcanic history of the region is due to Arnold Hague. The igneous rocks were described by Iddings in Monograph 32, Part II, and in this monograph reference is made to the account of the physiography of the Park by Hague in Monograph 32, Part I. It appears, however, that this part of the monograph has never been published, and we are dependent upon the brief summary of the geology of the Park which accompanies the folio

Hague's view of the volcanic history of the Park is embodied in the following table .

Pleistocene	Glacial drifts, etc.
Neocene	Basalt. Rhyolite Basalt Canyon Conglomerate. Basalt Andesitic flows and breccias Trachytic rhyolites Basic breccias.
Eocene	Acid breccias Pinyon Conglomerate
	Unconformity
Cretaceous	Laramie formation

The rocks to which special attention is directed are the trachytic rhyolite, which was assigned to a period during the accumulation of the Neocene volcanic breccias, and the two basalt flows with the intervening canyon conglomerate which were believed to underlie the rhyolite Since the canyon conglomerate yielded fragments of bones which were identified by Prof O C Marsh as belonging to the skeleton of a fossil horse of Pliocene time, the rhyolites must, according to this view, have been erupted at a late stage in the Pliocene period, and the erosion of the canyon through the rhyolites must have occurred at a still later period. As this interpretation of the relation of the basalts, canyon conglomerate, and trachytic rhyolite to the main

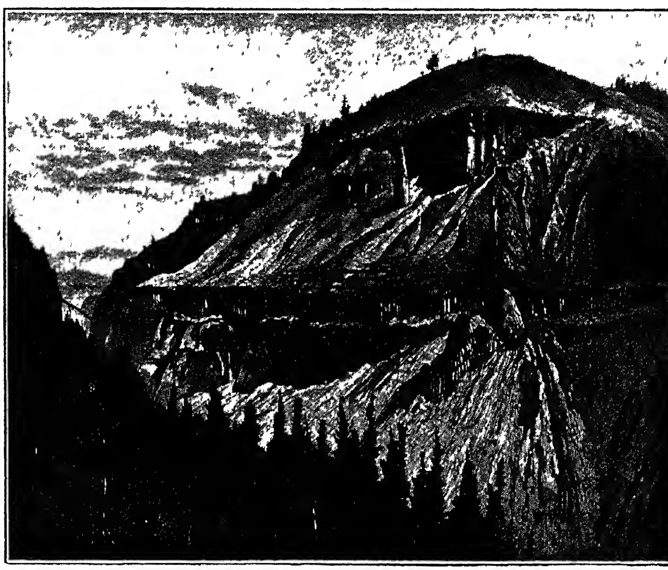

FIG 3—Drawing of section near Tower Falls by W. H Holmes From Hayden's 12th Annual Report of the Territories, 1878

rhyolite seemed to be at variance with the distribution of these rocks as shown on the geological map, Prof Field and I decided to investigate this problem further.

In various places on the route between Gardiner and Camp Roosevelt, which lies near the junction of the Yellowstone and Lamar Valleys, there are masses of

basalt and trachytic rhyolite which are obviously perched on narrow shelves on the valley sides and their situation is such that these lavas must have been poured out on to the floor of a pre-existing valley.

The most convincing evidence of the relation of the basalts to other rocks in the canyon is, however, obtained near the Tower Falls south of Camp Roosevelt, where Tower Creek drops into the Yellowstone Above Tower Falls the 'canyon' is a fairly wide valley with terraced slopes. Near Tower Falls the river swerves to the west and enters a very narrow canyon with almost precipitous walls of andesitic breccia which has been eroded into a striking series of pinnacles or 'needles'. This is the 'second canyon' of earlier observers, and is probably of postglacial origin Its rim is formed by a sheet of basalt with remarkably regular columnar jointing, this sheet is easily accessible on the road on the west side, where it rests on a conglomerate. On the east side the basalt overlies a conglomerate about 100 feet thick, underneath which is another band of columnar basalt (Fig 2) This striking section is among those drawn by W. H. Holmes, and a comparison of recent photographs with the sketch made more than fifty years ago demonstrates the remarkable accuracy of that artist (Fig 3).

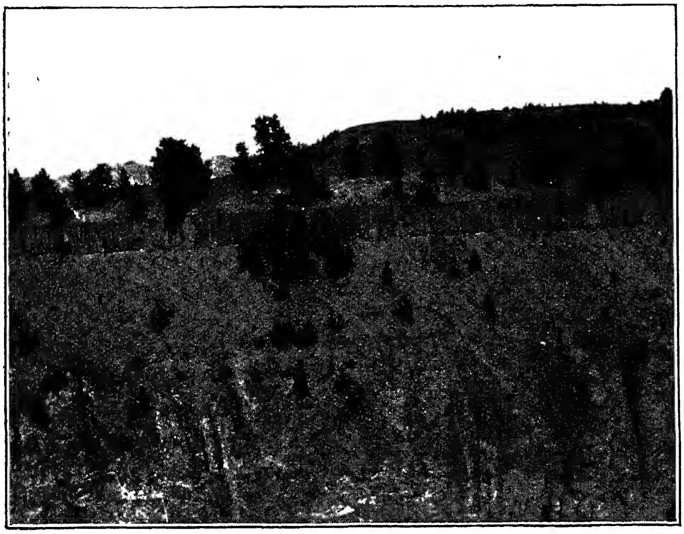

FIG 4 —Section in canyon below Tower Falls showing upper basalt and upper part of conglomerate resting on andesitic breccias Photograph by Prof O T Jones

If the east side of the second canyon be examined for about a mile below Tower Falls the upper basalt can be traced as a continuous band, but the lower basalt is only present at the north end and the south end, and is not visible in the intervening space, where also the conglomerate is reduced to about one-quarter of its thickness (Fig 4). This behaviour of the lower basalt and the conglomerate as seen from the west side of the canyon is due to the fact that the lower basalt and the lower part of the conglomerate pass behind a screen of the andesitic breccias which form the lower wall of the canyon In other words, the basalt and conglomerate series occupy an old valley, and the existing canyon has been eroded on the flank of that valley through the basalts and conglomerate into the underlying andesitic breccia. On the roadside south of Tower Falls the flank of the old valley stands at a still higher level, so that only a few feet of conglomerate separate the upper basalt from the andesitic breccias, ultimately it cuts out from below the upper part of the conglomerate, and the upper basalt then comes to rest on the andesitic breccias that formed the flank of the old valley There is here convincing evidence that the basalts and conglomerate have filled in a valley which formerly continued in the line of the wide part of the canyon above Tower Falls

In the same line about two miles farther north stands the striking feature known as Junction Butte The capping of the butte is basalt, while the lower part of it is composed of trachytic rhyolite Both here and in other places farther down the canyon, the relation of the basalts to the trachytic rhyolites appears to indicate that these two rocks belong to the same general period of eruption. A narrow outcrop of trachytic rhyolite is in fact represented on the geological map directly on the course of the buried canyon more than a mile south of Junction Butte

Holmes has also given a drawing of a sheet of basalt lying on conglomerate about half-way down the wall of the canyon, four miles above Tower Falls. Again, basalt overlying in places the canyon conglomerate is mapped on the floor of the wide Lamar Valley for a distance of 20 miles above Junction Butte.

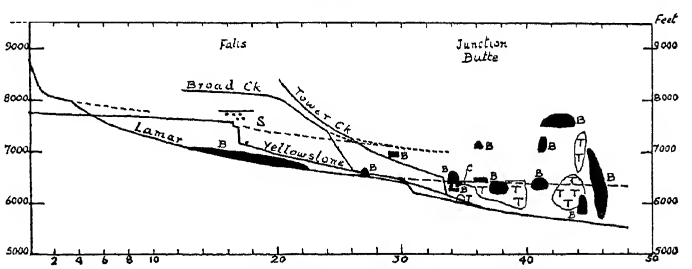

FIG 5 —Longitudinal profiles of Yellowstone and its principal tributaries, showing also the lava flow relics in relation to the profiles The black masses labelled B are basalts, the areas marked T are trachytes, C indicates the canyon conglomerate near Tower Falls, and S the sediments near the Yellowstone Falls

There is no doubt, therefore, that lava flows entered the Lamar Valley and penetrated for several miles into the canyon, and that near Tower Falls this filling of the older canyon is by a fortunate circumstance still preserved, and it confirms the suggestion made above that the damming of the canyon may have been due to lava flows.

If we inquire further into the distribution of the basalt relics that now lie in the flanks of the lower Yellowstone canyon—the 'third canyon' of previous

authors—we find that they rise in places to a level of between 7800 ft. and 8000 ft, whereas the highest level attained by the sediments near the Yellowstone Falls is a little above 7800 ft The lava surface stood, therefore, at a height sufficient to cause the filling of the upper end of the canyon to its very brim.

We turn now to a consideration of the longitudinal profile of the Yellowstone River and its principal tributaries The Lamar Valley profile shows clearly three cycles of erosion—the earliest cycle is only represented by a portion near the head of the valley, the second cycle extends down to within about five miles of Junction Butte, where the valley of the third cycle begins. In the Yellowstone there are three or perhaps even four cycles represented (Fig. 5)

There is some doubt whether the part of the valley above the falls or the portion between the two falls should be assigned to the first cycle, but it is immaterial in this connexion. The main canyon belongs clearly to the second cycle and the third canyon to the third cycle, the second canyon being probably due to a later and postglacial cycle. The greater part of Tower Creek pertains to the second cycle, and at present hangs conspicuously above the second canyon The profile of Broad Creek, which enters higher up the main canyon on the east side, is related as to its middle portion to the first cycle and as to its lower portion to the second cycle. Evidences of these cycles can also be traced in the transverse profiles of the various canyons. If now we project on to these profiles the outcrops of the basalt and trachytic rhyolite relics, we find that these descend at their lower ends to within about 100 feet of the river level in the third canyon and at their upper ends attain increasingly greater heights downstream.

It follows that these lava flows entered the canyon when the third cycle of erosion was far advanced

Since the main canyon which pertains to the second cycle was eroded through the rhyolitic rocks it is obvious that a great interval of time separates the eruption of the rhyolites and that of the valley basalts which occupied the valleys of the third cycle These considerations render it unthinkable that the basalts and conglomerates near Tower Falls were in existence prior to the eruption of the rhyolites. Moreover, there is reason to believe that the surface of the rhyolites had been reduced by prolonged erosion to a peneplain before the initiation of the first cycle of erosion The canyon cycle of erosion thus commenced a very long time after the eruption of the rhyolites, and as a result, it is assumed, of successive uplifts, rejuvenation brought about the erosion of the main canyon and later of the third canyon While the latter cycle was far advanced, eruptions of basalt and trachytic rhyolites dammed the canyon, and near the falls it was filled to the brim with sediments. Erosion was thus arrested and the canyon became a fossil canyon.

Since the lava eruptions of the Upper Pliocene the greater part of the lava dam has been removed, leaving only relics here and there as witnesses to the former extent of the lava floods. The erosion of the dam allowed of the removal of the sediments and the resurrection of the canyon. The original canyon is therefore an extremely ancient feature, dating probably from the Middle or Lower Pliocene

In conclusion, it gives me great pleasure to put on record the remarkable accuracy of Mr. Holmes's observations and his deductions made during the short period when he was examining the geology and physical features of the Park more than fifty years ago.

Mineral Industry of New South Wales.

THE Department of Mines of New South Wales has issued a very useful volume entitled "The Mineral Industry of New South Wales", written by E. C. Andrews and the staff of the Geological Survey, and edited by F. S. Mance, Under Secretary for Mines, who contributes two introductory sections. Such a work was long overdue; in 1901 a similar work, entitled "The Mineral Resources of New South Wales", was produced by Mr. Edward F. Pittman, at that time Government Geologist of New South Wales. This book contained a mass of useful information, and was in such demand that it has been out of print for many years When Mr Pittman's book was written, the most important mineral products of New South Wales were gold, copper, and tin, whereas to-day lead, zinc, and coal are of far greater importance

The general trend of mineral production in the State has been markedly upwards, and the value of these productions has risen tremendously The total value of the metals and minerals produced in the State of New South Wales to the end of 1927 is given as close upon 445 million pounds sterling, out of which the decade 1918–1927 has contributed no less than 155½ million pounds sterling, and there is every evidence that the upward trend is likely to continue

The present work covers satisfactorily the whole field of mineral production; it commences with a few brief sections of a general character, followed by a description of the occurrences of metals and metallic ores, d in alphabetical order, the only serious exception to this statement may be found in the fact that the four metals, silver, lead, zinc, and cadmium, are all lumped together mainly for the reason that the ores of these metals are generally found intimately associated. Of course by far the most important deposit of these minerals in the State of New South Wales is in the Great Broken Hill deposit, one of the most important in the world, not only on account of its magnitude, but also because the intimate admixture of ores occurring there has stimulated the ingenuity of inventors to devise processes which have since been applied successfully to deposits in all parts of the world

The third part of the book consists of a description of the occurrences of non-metallic minerals, also arranged in alphabetical order. The term 'non-metallic' minerals is used in its ordinary acceptance, compounds of the elements which the chemist would speak of as metals of the alkalis, and the alkaline earths being, in accordance with ordinary everyday usage, spoken of as non-metallic substances The work is a very complete one, and will no doubt satisfactorily fulfil its object of presenting to the reader a brief but accurate and authoritative description of the mineral wealth of New South Wales.

University and Educational Intelligence.

CAMBRIDGE —The Director of the Observatory has, with the consent of the Vice-Chancellor, reappointed Dr. W. M Smart, of Trinity, as chief assistant at the Observatory for five years.

The Sudbury Hardyman Prize at Emmanuel College, offered to a graduate of less than M A. standing, has been awarded to A. H. Wilson for a dissertation on "Quantum Mechanics" Special dissertation prizes have been awarded to C B. Allsopp (physical chemistry) and J. G. A. Griffiths (chemistry)

SIXTY-NINE 'land-grant' colleges and universities have been established in the United States under a series of Acts, beginning in the year 1862, for the granting of land for financing education in agriculture

and the mechanic arts. The sixtieth annual report of the Bureau of Education on these institutions (*Bulletin* No 14; 1928) shows that from small beginnings they have by degrees become leading factors in higher education, enrolling, as they do, more than two-fifths of all the university and college students in the United States Land-grants now provide only a small fraction of their total revenues In 1926–27 the land-grants and other federal aid amounted to only four million dollars out of receipts amounting in the aggregate to 137 million dollars Twenty-six of them with receipts amounting to 78 million dollars are now combined land-grant colleges and State universities Agriculture attracts only a small and diminishing number of students. In 1927 only seven and a half per cent of the resident students in the 52 institutions attended by white students were pursuing agricultural courses, while twenty per cent and five per cent were students of engineering and home economics respectively. In the 17 negro colleges, out of 7018 students enrolled in regular courses, 965 were studying agriculture, 1672 trades and mechanic arts, and 1630 home economics A comprehensive national survey by the Bureau of Education of the land-grant colleges is now in progress

THE annual conference of the Association of Teachers in Technical Institutions was held in Liverpool during the Whitsuntide holiday In his presidential address, the new president, Mr A. E. Evans, of the Battersea Polytechnic, pursued two main arguments which deserve special and serious attention, particularly in view of the educational reorganisation which is now proceeding. The first was that local and regional inquiries into the question of education and industry, and the setting up of occasional committees such as those for engineering and salesmanship, are not, in themselves, sufficient to solve the problems which have already received the attention of such national inquiries as those made by the Malcolm and Emmott Committees. Both these bodies saw the necessity of establishing a small national committee the duty of which would be to co-ordinate local and regional effort and to act as a clearing house for suggestions made towards the solution of the many problems now being presented No concerted national action is possible without such a body, and, until it is set up, only piecemeal attempts at advance can be made While welcoming the recently appointed committee on salesmanship, Mr. Evans insisted that production is the first necessity if our industrial problems are to be solved, new methods and new processes must be developed and devised, and new links made between the operations underlying production and the creation of power Mr. Evans's second argument was one with which readers of NATURE are already familiar. In spite of the lip-service paid to the new conception of education with which our scientific and industrial civilisation is concerned, there is still a great tendency for educationists to regard with distrust schemes and curricula which deal with the application of science to industry, and to preserve, therefore, an attitude of remoteness from the everyday world. They forget, in their adoration of poets and artists and philosophers, the scientific workers, engineers, builders, and architects from whom technical institutions are handing down the means of lightening the burdens of mankind. Among resolutions dealt with by the Conference was one on the position of the junior technical school in the educational system. It was the result of a lengthy inquiry made by the Association which included special attention to the way in which these schools have been able to satisfy the demands of industrialists for employees able to adapt themselves to the changing needs of industry.

Calendar of Patent Records.

June 1, 1818 —The first French aeronautical patent was that granted to P C Verger on June 1, 1818, for a dirigible airship. The ship, in the shape of a fish, was propelled by manually operated fans and was caused to rise or descend by a weight which could be moved along the length of the ship According to the patent specification, successful flights had been made in which the airship had been driven and manœuvred with ease, but there is no other record of these flights. The ship bears a close resemblance to that proposed by Pauly and Egg, which had been patented in Great Britain three years earlier.

June 4, 1872 —Vaseline was patented in the United States by R. A. Chesebrough, of New York, on June 4, 1872, the word being used for the first time in the specification of this patent It was decided in the British courts that the word became one descriptive of the substance on the lapse of the patent rights in Great Britain, and could not be registered as a trade-mark

June 5, 1787 —William Symington's steam engine, which was patented on June 5, 1787, was originally intended for a road carriage, but its chief claim to importance lies in the fact that it was used by Patrick Miller in the first practical attempts at steam navigation in Great Britain, a small double-hulled paddle boat, with the paddle wheels placed between the two hulls and originally driven by man power, being successfully propelled by it on Dalswinton Lake in 1788. In the following year a larger vessel of the same type was propelled on the Forth and Clyde Canal at a speed of 5 miles an hour, but after a few trials the experiments were abandoned, and were not resumed until the *Charlotte Dundas*, with a new engine, was launched in 1803

June 5, 1854.—James Bowman Lindsay was the first to propose a definite scheme for connecting Britain and America by wireless telegraphy. His invention for a method of transmitting telegraphic messages by electricity through and across water without submerged wires, the water being made available as the conducting medium, was patented on June 5, 1854. Signals were successfully transmitted across the River Tay (a distance of about ½ mile), and Lindsay calculated that with two stations, one situated in Cornwall and one in Scotland, and two correspondingly disposed stations in America, communication could be obtained across the Atlantic.

June 7, 1821 —The use of the rocket for the killing and capturing of whales was patented by Sir William Congreve and J N Colquhoun on June 7, 1821. The specification includes a description of the rocket-bomb, which was afterwards re-invented in America and became one of the most deadly weapons used in whale-fishing

June 9, 1840.—It was Thomas Edmondson who first thought of issuing railway tickets in their present form. His patent, dated June 9, 1840, had for its object the printing of "cardboard tickets in such a manner that each ticket should bear a progressive number or figure and thus, by being delivered in successive rotation to the passengers, the way bills would be readily made out, a most perfect check could be kept upon all clerks or other officers engaged in receiving money, and a daily or weekly return could be readily made merely by noting the opening and closing numbers of the tickets delivered". The invention comprised a printing machine for printing the cardboard blanks with the proper letterpress and successive numbers, and a dating machine which was put into operation by pushing the end of the ticket into the apparatus.

Societies and Academies.

LONDON.

Linnean Society, May 2.—H. H. Haines: Some aspects of the New Forest, with special reference to the changes wrought by direct or indirect human agency. The poverty of the reproduction of trees and the poor aspect of the young growth is due chiefly to the grazing, browsing, and trampling of domestic animals, as also is the entire composition of parts of the vegetation. The first evident results of excessive browsing is the gradual reduction of the underwood to thorny, prickly, or otherwise distasteful species. The herbaceous flora and fauna are affected by grazing, but also very largely by collectors and the direct action of man in clearing and draining. The impoverishment of the fauna and flora of the open heaths is partly accounted for by too much and too severe burning.—F. S. Russell: The Great Barrier Reef Expedition and its aims. The expedition is based on Low Island, forty miles north of Cairns, North Queensland, and situated eight miles from the mainland and midway between the coast and the great barrier itself. The shore party is undertaking an ecological survey of the island and adjacent barrier reef, studies in the growth of coral, and life-histories of economic products, and experimental work on the feeding habits of corals are being carried out in the laboratory. The sea work entails a complete seasonal survey of the chemical constituents of the sea water and of the plant and animal plankton, together with physical observations such as temperature and transparency (see NATURE, Jan. 19 and May 18).—G. Tandy: The vegetation of the Great Barrier Reef. There is a mangrove swamp to windward (with *Rhizophora mucronata* the dominant) and a more or less vegetated cay of coral sand to leeward as is found on many islands north of Low Island. The formation depends on the South-East Trade Wind, which is fairly constant here from April to November. In early morning it will be at S.S.E. and light, but as the day goes on it will shift to E.S.E. or even E. and freshen. The heaviest seas are thus on the north side of the mangrove island, and the drift of the coral shingle is driving the mangrove back. On the lee side of the swamp, however, they are extending in a westerly direction.—H. W. Pugsley: A revision of the British *Euphrasiæ*. The British species of *Euphrasia* were first studied by the late F. Townsend, who published a monograph in 1897, adapted from the larger work of Prof. E. von Wettstein of the preceding year. The relationship of the generic subdivisions, as given by Wettstein, is open to criticism.

PARIS.

Academy of Sciences, April 22.—Jean Baptiste Senderens: The preparation of the ether-oxides of the aromatic alcohols by the catalytic action of the alkaline bisulphates. Benzyl alcohol and phenylethyl alcohol are readily converted into the corresponding ethers by the action of sodium bisulphate. Mixed ethers, such as $C_4H_9-O-CH_2(C_6H_5)$, can be prepared in a similar way.—J. Herbrand: Some properties of true propositions and their applications.—Bertrand Gambier: Moutard equations with quadratic integrals.—Ragnar Frisch: A general formula of the mean.—Arnaud Denjoy: A class of analytical functions.—H. Mineur: The rotation of the local (star) cluster.—P. Lejay: A chronograph recording the ten-thousandth of a second and its application to the measurement of the irregularities of astronomical pendulums. A development of the method described in an earlier communication for recording the passage of a pendulum through the vertical without using contacts.—J. Barthoux: Badakchan. An outline of the physical and geological features of this Afghan province.—L. Décombe: Electrified spherical pellicles and the Stark effect.—Henri Chaumat: The calculation of electrostatic machines.—J. Vuillermoz: The reversible electromotive force of electrolysis.—H. Weiss and E. Vellinger: The measurement of the interfacial tension between mineral oils and aqueous solutions. The influence of the degree of refining and of the degree of alteration of the oils.—S. Piña de Rubies: The arc spectrum of samarium. Measurements made at the normal pressure between 2750 A. and 2200 A.—R. Soulillou: The separation of the various spark spectra of antimony. The spark lines of antimony can be split up into three groups, probably Sb II., Sb III., and Sb IV.; the last two named are perfectly homogeneous, but the first, which is rich in lines, appears to consist of two sub-groups.—D. Chalonge and M. Lambrey: The continuous spectrum of the hydrogen tube. The influence of the following variables on the intensity of the continuous spectrum of hydrogen has been studied: the pressure of the hydrogen, the intensity of the discharge current, the dimensions of the tubes. The results suggest that it should be possible to use these tubes as standards of intensity in the ultra-violet.—F. Joliot: A new method of studying the electro-chemical behaviour of substances in very dilute solution. The velocity of deposition of the substance under examination is determined by measuring the increase in the optical density of a gold or platinum electrode transparent to light, a photoelectric cell being used for the light measurement. Details are given of the determination of the potential of the deposit of bismuth on a gold electrode, the quantities deposited being less than 10^{-5} gm.—E. Rinck: The equilibrium in the liquid state between potassium, sodium, and their bromides. The law of mass action, (Na) (KBr)/(K) (NaBr) = c, has been verified, and for temperatures from 900° C. to 1000° C. the constant c does not vary appreciably with the temperature. From this it follows that thermal effect of the reaction $Na + KBr \rightleftharpoons K + NaBr$, which at the ordinary temperature is -9.5 cal., is nearly zero at 800°-1000° C.—F. Bourion and Ch. Tuttle: The cryoscopic determination of the molecular equilibria of resorcinol in aqueous solutions of potassium chloride.—Jean Calvet: The corrosion of aluminium. Three specimens of aluminium were used in these experiments, one purified by Hoopes method (99·94 per cent Al), and two commercial metals (99.75 and 99·18 per cent Al). The extra pure aluminium (Hoopes) showed a marked increase of resistance to attack by solutions of hydrochloric, nitric, sulphuric, and phosphoric acids.—Jean Lugeon: A method of investigating the atmosphere by means of the disturbances of the electromagnetic field at the time of the passage of a crepuscular band.—A. P. Dutertre: The discovery of fossil bones of fishes in the Devonian of the Boulonnais. An account of a new species of *Ganorhynchus* (*G. Rigauxi*) found in the limestone of Ferques at Beaulieu (Pas-de-Calais). This is comparable with that which has been described and figured by R. H. Traquair under the name of *G. Woodwardi*, and appears to be the only representative of the genus *Ganorhynchus* in Europe.—A. Paillot: Bacterial symbiosis and humoral immunity in the Aphides.—Armand de Gramont: The application of binocular vision to fixing direction.—Jean Timon-David: The action of bromine on insect oils. Figures are given for the hexabromide figure (Hehner and Mitchell method) of several insect oils, and a rough classification is attempted.—H. Wunschendorff and Ch. Killian: New observations on the

metabolism of *Ustulina vulgaris*.—Mme Phisalix Some comparative properties of antirabic sera from vaccinated animals and natural antirabic sera.

GENEVA.

Society of Physics and Natural History, Mar. 7 — P Balavoine Observations on ice. The water from melted ice is always slightly turbid, this is not a sign of impure water, but is due to the calcium salts crystallised during the solidification failing to redissolve Ice, moreover, absorbs ammonia from the surrounding air, and water from melting ice may contain ammonia without the original water having been contaminated —Ed Parejas Geological observations in Corsica (3) The red deposits of Caporalino This formation occurs at the base of the Neojurassic limestones of Caporalino. The latter are mixed with thin layers at their base In the absence of any characteristic fauna, there are as good grounds for correlating the red deposits of Caporalino with the red Oxfordian-Argovian of the median Prealps as with the Upper Cretaceous, all the more that they appear to lack the Foraminifera usual in the Upper Cretaceous —A. Liengme . The effect of intracardiac injections of adsorbent carbon in the guinea-pig and white rat Intracardiac injections of carbon in the form of Indian ink in suspension in physiological serum are innocuous Intracardiac injections in doses of 4 milligrams or more per kilogram of live weight of Merck adsorbent carbon, in suspension of 1 per cent in physiological water, cause immediate death. Smaller doses produce total loss of muscular tone with clonic shocks in the posterior limbs. After several hours of severe discomfort, the animal returns to its normal condition Doses of Merck carbon eight times the lethal dose are innocuous if first mixed with a sufficient quantity of fresh human or guinea-pig serum —L W Collet and Ed Paréjas · The geology of the Hockenhorn The unfolding of the Morcles-Doldenhorn nappe has produced a crystalline wedge which has broken its sedimentary covering, has scraped it in part, and has even penetrated the opposite side of the layer —L. W Collet and G. Rosier A new crystalline wedge in the Inner Faflertal (Lotschental) By the discovery of a new crystalline wedge in the Inner Faflertal, the authors point out a correction required in the geological map of the Jungfrau of L. W Collet and Ed Paréjas —G. Rosier . A granitic mylonite of the Baltschiederlucke, the Bietschhorn massif There is at the Baltschiederlucke a zone of granitic mylonite connected with a plane of overlapping The mylonite contains lenses of crystalline schist of unknown origin ; it is composed of albite and microcline cemented by a fine material, consisting for the most part of crushed quartz The microcline, not twinned, can only be identified by Fedorof's method —A Falconnier : The stratigraphy of the Sequanian in the anticlinal chain of Noirmont, Creux du Cruaz, near Saint-Cergues. The Sequanian there comprises three divisions (1) The lower, with marls and limestones containing *Astarte vocetica, Perisphinctes Streichensis, P Fontannesi*, 35 metres; (2) middle reef facies, 60 metres, (3) upper, limestone-marl with *Perisphinctes inconditus*, and *P. Lothari*, 20 to 30 metres. It corresponds with the horizons of the Geissberg, Wangen, and of Baden below the Argovian of the Jura It is defined by zones with *Peltoceras bimammatum* and *Perisphinctes Achilles* of Haug.—J. Pilloud · The presence of the upper Lias, the Gault and the Barremian at Voirons (Préalpes externes, Haute-Savoie) The discovery of fossils has enabled the author to determine the presence at Voirons of the Gault (zone with *Leymeriella tardefurcata*), of the Barrémian (limestones with Desmoceras), and of the upper Lias (zone with *Lioceras opalinum*) —R. Wavre . The moments of inertia of the terrestrial ellipsoid. The author gives a new formula for the constant of precession of the equinoxes, and he extends that of Poincaré to the whole of the equipotential surface exterior to the planet

ROME

Royal National Academy of the Lincei, Feb 17.— G Scorza · Riemannian matrices With the help of the theory of algebra, together with the results already obtained by the author concerning Riemannian matrices, Rosati's fundamental theorem of matrices may be deduced readily from his observations on the pseudo-axes of such a matrix. Rosati's statement with regard to the indices of what he calls minimum invariant varieties is contained in propositions already established in the author's earlier publications —R. Marcolongo The geometrico-mechanical investigations of Leonardo da Vinci These investigations are classified into the following groups : on lunes and on the quadrature of plane figures limited by circular arcs , on the transformations of solids into equivalent solids under given conditions ; on the problem of incidence or Alhazen's problem ; on the centres of gravity of plane and solid figures ; on the construction of mathematical instruments. Leonardo discovered and demonstrated the theorem of the meeting point of the axes of a tetrahedron, but it does not appear that he showed this to be the baricentre of the tetrahedron For the centre of gravity of a semicircle he not only gave an approximate calculation, but he also used the method of decomposition into elementary sectors, thus reducing the problem to that of the graphic composition of a system of parallel forces. With slight variations, his precision compasses are still sold, and he designed also a parabolic compass —A Amerio . New method for measuring the velocity of sound in liquids. In this method, use is made of the very sensitive property of the ear which allows it to determine the direction of origin of a sound when this lies in the horizontal plane passing through the ears —S. Franchi · The importance of the San Remo and Imperia sheets of the 1 . 100,000 geological map of Italy for the solution of questions of Alpine and Apennine geology.— A Comessatti : The curves of Galois (1).—T. Boggio : Riemann's homograph for the hyper-surfaces of a curved space.—S Cherubino . Decompositions in sums of squares of definite and semi-definite polynomes —E. Bompiani The elements of the second order of curves of a surface In previous notes the convenience of associating, with an element of the second order of a curve traced on a surface of ordinary space, two quadrics termed asymptotic osculatory quadrics of the element, was indicated Considerations analogous to those evolved in these notes point to the possibility of associating with such an element two new quadrics, of which the equations are now given —N. Mouskhelichvili : The problem of the torsion of isotropic elastic cylinders —A. Masotti : The dynamic actions in a system of rectilinear vortices —G. B Lacchini · The limits of visibility with refractors of small dimensions.—A. Carrelli Broadening of lines by resonance (2) Experimental results are given which, in conjunction with those of the author's previous communication on this subject, show that the widening of a spectral line in emission varies as the square root of the concentration of the vapour, and that the distribution of the intensities follows an exponential law. These conclusions were derived by Holtzmark on the basis of the theory of absorption founded on the mutual action of similar resonators.—Angelina Cabras Functional operations of mathematical physics represented as rational

functions of the symbol of derivation —B. Rossi The Raman effect and negative absorption The Raman effect is usually regarded as an experimental proof of the induced emission or negative absorption postulated by Einstein in his deduction of Planck's formula Closer examination of this interpretation reveals difficulties. Thus, if Einstein's induced emission resembles a Raman effect of the second species, it should possess a frequency double that absorbed or emitted spontaneously by the atom Exact analysis shows that the corpuscular theory of light renders it possible to unite the Raman effect and the phenomena of absorption and emission (spontaneous and induced) in a coherent scheme, according to which the Raman effect of the second kind is considered as a super-elastic impact of a light quantum with an excited atom, and induced emission as a modification of the probability that an atom will emit a radiation of given frequency as a result of the presence of other quanta of the same frequency — G. Malquori The system, $Fe(NO_3)_3-HNO_3-H_2O$ at 25° Study of this system gives results which exclude the existence of the acid salt Fe_2O_3, $4N_2O_5$, $18H_2O$ and indicate the presence, in solutions highly concentrated as regards nitric acid, of the solid phase $Fe(NO_3)_3$, $6H_2O$ —D Bigiavi and S. Stefanic Action of diazotates on azoxyphenols. When treated with bromophenyldiazonium hydroxide, α-benzeneazoxyphenol yields directly the corresponding hydroxyazo-compound, whereas its β-isomeride gives a diazo-ether, which is able to undergo coupling with β-napthol and also rapid transformation into the isomeric hydroxyazo-compound —V. Montoro The supposed sesquioxide of molybdenum According to Guichard (1901), molybdenite is converted into the compound Mo_2S_3 when heated in a carbon crucible in the Moissan furnace for four minutes by an arc carrying 900 amperes at 50 volts. X-ray examination of a number of specimens of molybdenite partially desulphurised in this way shows, however, that these consist of mixtures of the disulphide with solid solutions of carbon in molybdenum. This result confirms Parravano and Malquori's conclusion, drawn from an investigation of the equilibrium of the reduction of molybdenite by hydrogen, that no molybdenum sulphide exists which is less rich in sulphur than the disulphide.—L. Passerini : Investigations on spinels The compound $MgCr_2O_4$, obtained by calcining a mixture of the nitrates of the two metals at about 800°, and $NiFe_2O_4$, similarly obtained from the corresponding hydroxides, crystallise in the cubic system with a lattice structure of the spinel type For $MgCr_2O_4$ the side of the unit cell is $a = 8\ 290 \pm 0{\cdot}005$ A , the volume of the cell $v = 569\ 72 \times 10^{-24}$ c c , and the calculated density 4 49 , for $NiFe_2O_4$ the corresponding magnitudes are $8{\cdot}340 \pm 0{\cdot}005$ A , 580 09 $\times 10^{-24}$ c c , and 5 268 respectively.—C. Antoniani and G. Fonio Investigations on the interchange of the phosphoric acid of the soil with arsenic acid. When soil which has been treated with sodium phosphate is afterwards treated with dilute arsenic acid solution, the phosphate anion is replaced to some extent by the arsenic anion —G. Mezzadroli and E. Vareton : Action exerted by an oscillating metallic circuit on the germination of seeds. Experiments with beans, wheat, barley, and beet show that the presence of an oscillating circuit with a single coil, 30 cm in diameter, capable of catching natural cosmic waves of wave-length about 2 metres, exerts a favourable influence on the germinating power of seeds, the time of germination being reduced, in some cases, by one-half.—M Cassinis and L Bracaloni · Hydremic curves.—B. Alosi Hæmolytic poisons and alterations of the liver.

Official Publications Received.

BRITISH

Sugar Beet Problems Report of Second Conference held at the College on Wednesday, January 23rd, 1929 Pp 44 (Newport, Salop Harper Adams Agricultural College)

The Cultivation and Manuring of Sugar Beet Pp 23 (Newport, Salop Harper Adams Agricultural College)

Royal Botanic Gardens, Kew Bulletin of Miscellaneous Information, 1928 Pp iv+416+103 (London H M Stationery Office) 12s 6d net.

The Journal of the Royal Agricultural Society of England Vol 89 Pp 8+322+clxxiv+xii (London John Murray) 15s

Manchester Municipal College of Technology Summer Evening Classes Prospectus of Short Courses of Lectures and Laboratory Work to be given during the Summer 1929 Pp 26 (Manchester)

Survey of India Geodetic Report, Vol 2 From 1st October 1925 to 30th September 1926 Pp xi+73+3 plates+6 charts 3 rupees , 5s 3d Records of the Survey of India Vol 22 Exploration of the Shaksgam Valley and Aghil Ranges, 1926 By Major Kenneth Mason Pp xi+182+16 plates 3 rupees , 5s 3d (Dehra Dun)

University Grants Committee Returns from Universities and University Colleges in receipt of Treasury Grant, 1927–1928 Pp 24 (London H M Stationery Office) 3s net

The Journal of the East Africa and Uganda Natural History Society Nos 33 and 34, May and September 1928 Pp 73+26 plates (Nairobi) To Members, 7s 6d , to non-Members, 15s

The National Institute for Research in Dairying its Work and Needs Second edition Pp 60 (Reading)

Proceedings of the Cambridge Philosophical Society Vol 25, Part 2, April Pp 121-254 (Cambridge At the University Press) 7s 6d net

The Scientific Proceedings of the Royal Dublin Society Vol 19 (N S), No 20 A Study of Lactose-fermenting Yeasts isolated from Milk, Cream and Butter By M Grimes and J Doherty Pp 261-264 (Dublin Hodges, Figgis and Co , London Williams and Norgate, Ltd) 6d

British Science Guild The Annual Report of the Executive Committee, 1928–9, presented at the General Meeting of Members, held at the Hotel Cecil, Strand, London, 8th May 1929 Pp 28 (London) 1s

Memoirs of the Asiatic Society of Bengal Vol 11, No 2 The Language of the Mahā Naya-Prakāsa , an Examination of Kāshmīrī as written in the Fifteenth Century By Sir George A Grierson Pp ii+73-130 (Calcutta) 2 4 rupees

Indian Journal of Physics, Vol 3, Part 3, and Proceedings of the Indian Association for the Cultivation of Science, Vol 12, Part 3 Conducted by Prof C V Raman Pp 307-450 (Calcutta) 3 rupees , 4s

Papers and Proceedings of the Royal Society of Tasmania for the Year 1928 Pp v+191+32 plates (Hobart) 10s

Dominion of Canada Report of the Department of Mines for the Fiscal Year ending March 31, 1928 (No 2182) Pp vi+65 (Ottawa F A Acland) 15 cents

Canada Department of Mines Geological Survey Summary Report, 1927, Part A (No 2162) Pp 65A Summary Report, 1927, Part B (No 2172) Pp 94B (Ottawa F A Acland)

Transactions and Proceedings of the Royal Society of South Australia (Incorporated) Vol 52 Edited by Prof Walter Howchin, assisted by Arthur M Lea Pp iii+275+22 plates (Adelaide) 17s

Southern Rhodesia Report of the Director, Geological Survey, for the Year 1928 Pp 18 (Salisbury, S R)

Modern Safety Rules for use in Chemical Works Part 1 Model Rules Pp 39 (London Association of British Chemical Manufacturers)

Proceedings of the Society for Psychical Research Part 110, Vol 38, May Pp 281-408 (London Francis Edwards, Ltd) 5s

The Scottish Forestry Journal being the Transactions of the Royal Scottish Arboricultural Society Vol 43, Part 1, March Pp iii+80+36 (Edinburgh) 7s 6d

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 67, No 389, May Pp 557-684+xxxviii (London E and F N. Spon, Ltd) 10s 6d

The Linen Industry Research Association Report of the Council, 1928 Pp 24 (Lambeg, Co Antrim)

Agricultural Progress the Journal of the Agricultural Education Association Vol 6, 1929 Pp 157 (London Ernest Benn, Ltd) 5s net

Tanganyika Territory its Geology and Mineral Resources Pp 23. (Dodoma Geological Survey)

Proceedings of the Royal Society of Edinburgh, Session 1928–1929 Vol 49, Part 2 The Thermal Equilibrium between Ethylene, Iodine and Ethylene Di-iodide By R B Mooney and Dr E B Ludlam Pp 160-169 (Edinburgh Robert Grant and Son , London Williams and Norgate, Ltd) 1s

FOREIGN

Carnegie Endowment for International Peace Division of Intercourse and Education Annual Report of the Director for the Year 1928 By Nicholas Murray Butler Pp 93+7 plates (New York City)

The Science Reports of the Tohoku Imperial University, Sendai, Japan. Second Series (Geology), Vol 13, No 1 Pp 15+8 plates (Tokyo and Sendai Maruzen Co , Ltd)

Proceedings of the Third Pan-Pacific Science Congress, Tokyo, October 30th–November 11th, 1926, held under the Auspices of the National Research Council of Japan and through the Generosity of the Imperial Japanese Government Vol 1 Pp x+1220 Vol 2 Pp xvi+1221-2678 (Tokyo National Research Council of Japan)

Territory of Papua Native Education the Language of Instruction and Intellectual Education By F E Williams (Anthropology, Report No 9) Pp 25 (Port Moresby Government Printer)

Scientific Papers of the Institute of Physical and Chemical Research Nos 186-187 A Rosy Muscovite from Suizawa and a Dark-grey Muscovite from Doi, by Satoyasu Iimori and Jun Yoshimura , A Pink Kaolin, and Ruthenium as a Minor Constituent of the Tanokami Kaolins, by Satoyasu Iimori and Jun Yoshimura Pp 221-228 (Tōkyō Iwanami Shoten) 20 sen

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan Vol 22, Part 2 Über den Einfluss meteorologischer Faktoren auf den Baumzuwachs ii Untersuchungen uber das Langenwachstum einer Schwarzkiefer unter Verwendung eines neuen Hohenzuwachsautographs Von Hirokichi Nakashima Pp 301-327+Tafel 10-15 Vol 20, Supplementary No · A Monograph of the Dibranchiate Cephalopods of the Japanese and adjacent Waters By Madoka Sasaki Pp v+357+30 plates (Tokyo · Maruzen Co, Ltd)

Proceedings of the United States National Museum Vol 75, Art 2 Beetle Larvae of the Subfamily Galerucinae By Adam G Boving (No 2773) Pp 48+5 plates Vol 75, Art 4 A Review of the Birds of the Islands of Siberut and Sipora, Mentawi Group (Spolia Mentawiensia) By J H Riley (No 2775) Pp 45+1 plate. Vol 75, Art 8 Notes on some North American Moths of the Subfamily Eucosminae By Carl Heinrich (No 2779) Pp 23+5 plates Vol 75, Art 6 Some New Genera and Species of Nematode Worms, Filarioidea, from Animals dying in the Calcutta Zoological Garden By Asa C Chandler (No 2777) Pp 10+3 plates (Washington, D C Government Printing Office)

U S Department of Agriculture Farmers' Bulletin No 1588 Frost and the Prevention of Frost Damage By Floyd D Young Pp 62 (Washington, D C Government Printing Office) 10 cents

Department of Commerce Bureau of Standards United States Government Master Specification, No 23c Lamps, Electric, Incandescent, Large, Tungsten Filament Pp ii+3 5 cents United States Government Master Specification, No 618 Lamps, Electric, Incandescent, Miniature, Tungsten Filament Pp ii+3 5 cents (Washington, D C Government Printing Office)

Sudan Notes and Records Vol 11, 1928 Pp iv+242 (Khartoum Sudan Notes and Records, London Sudan Government Office) 30 P T, 6s

University of Illinois Engineering Experiment Station Bulletin No 189 Investigation of Warm-Air Furnaces and Heating Systems The Research Residence, Part 4 By Prof Arthur C Willard, Prof Alonzo P Kratz and Prof Vincent S Day Pp 114 60 cents Bulletin No 190 The Failure of Plain and Spirally Reinforced Concrete in Compression By Prof Frank E Richart, Anton Brandtzaeg and Rex L Brown Pp 72 40 cents (Urbana, Ill)

Suomen Geodeettisen Laitoksen Julkaisuja No 11 Die Beobachtungsergebnisse der Triangulation in den Jahren 1926–1928 Pp ii+139 (Helsinki)

A Series of Fourteen Radio Talks on Science for the Home Manager By Dr George D Beal, H S Coleman, E R Harding, Dr O F Hedenburg, R H Heilman, L E Jackson, Dr. H M Johnson, H M Marc, H K Salzberg, Dr Erich W Schwartze, Dr T H Swan, Dr R B Trusler, Dr O E Jennings (Radio Publication No 48, University of Pittsburgh) Sponsored by Mellon Institute of Industrial Research, and Broadcast from the University of Pittsburgh Studio of KDKA, Westinghouse Electric and Manufacturing Co, Pittsburgh, Pennsylvania, 1929 Pp 138 (Pittsburgh, Pa University of Pittsburgh) 75 cents

Proceedings of the Imperial Academy Vol 5, No 3, March Pp v-vi+103-160 (Tokyo)

Preussische Staatsbibliothek Handbibliothek des grossen Lesesaals, Abteilung 7 Mathematik und Naturwissenschaften Pp viii + 75 (Berlin Staatsbibliothek)

Japanese Journal of Mathematics Transactions and Abstracts Vol 5, No 4, March Pp iv+269 367+13-39+vi+iv Vol 6, No 1, March Pp 171 (Tokyo National Research Council of Japan)

Proceedings of the California Academy of Sciences, Fourth Series Vol 18, No 12 The Faunal Areas of Southern Arizona, a Study in Animal Distribution By Harry S Swarth Pp 267-383 (San Francisco)

Bulletin of the American Museum of Natural History Vol 59, Art 1 Pelmatozoan Root-Forms (Fixation) By Kurt Ehrenberg Pp 76 (New York City)

The University of Colorado Studies Vol 17, No 1 Pp ii+44 (Boulder, Colo) 1 dollar

Koninklijk Nederlandsch Meteorologisch Instituut No 102 Mededeelingen en Verhandelingen, 29b Klimatologie van den Indischen Oceaan Door P H Gallé (With English Summaries) Pp 34 0 75 fl No 102 Mededeelingen en Verhandelingen, 30 The Influence of Sea Disturbance on Surface Temperature By P M van Riel Pp 17 0 30 fl No 106a Ergebnisse aerologischer Beobachtungen 16, 1927 Pp iv+44 2 50 fl No 108 Seismische Registrierungen in De Bilt 14, 1926 Pp ix+63 1 00 fl (Amsterdam Seyffardt's Boekhandel)

CATALOGUES.

Watson's Microscope Record No 17, May Pp 32 (London W Watson and Sons, Ltd)

Preliminary Summer List, 1929 Pp 4 (London W Heffer and Sons, Ltd)

Liver Therapy · some Clinical Evidence of its Value in Pernicious Anæmia Pp 8 (London The British Drug Houses, Ltd)

Diary of Societies.

FRIDAY, MAY 31

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Prof E N da C Andrade The Air Pump Past and Present

MONDAY, JUNE 3

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 4 —Special General Meeting

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4 30 —Sir Ambrose Fleming. Nature and the Supernatural (Presidential Annual Address)

ROYAL SOCIETY OF EDINBURGH, at 4 30 —Prof W C M'Intosh On Abnormal Teeth in certain Mammals, especially in the Rabbit —Dr I Sandeman Bands in Hydrogen related to the Fulcher System —J A V Butler and W O Kermack The Action of Salts of Polynuclear Bases on Colloidal Suspensions and on the Electro-capillary Curve —Sir Thomas Muir The Theory of Skew Determinants and Pfaffians from 1891 to 1919

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 —General Meeting

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6 —Miss E M Terry Individual 'Difficult' Children

TUESDAY, JUNE 4

INSTITUTION OF GAS ENGINEERS (at Institution of Civil Engineers), at 10 A M —Annual General Meeting (continued on June 5, 6, and 7)

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5 —Dr H H Dale Some Chemical Factors in the Control of the Circulation (Croonian Lectures) (I)

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E C), at 6 30 —H J Burkill The Yorkshire Derwent

ILLUMINATING ENGINEERING SOCIETY (Annual General Meeting) (at Royal Society of Arts), at 7 —Dr J F Crowley Some Further Applications of Synchronously Intermittent Light for Revealing Moving Machinery

WEDNESDAY, JUNE 5

ENTOMOLOGICAL SOCIETY OF LONDON, at 8 —Dr H Scott An Entomological Excursion into Basuto Land

THURSDAY, JUNE 6.

ROYAL SOCIETY, at 4 30 —Prof E A Milne The Structure and Opacity of a Stellar Atmosphere (Bakerian Lecture)

INSTITUTE OF PATHOLOGY AND RESEARCH (St Mary's Hospital), at 5 —Prof W Bulloch The History of Bacteriology

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5 —Dr H H Dale Some Chemical Factors in the Control of the Circulation (Croonian Lectures) (II)

CHEMICAL SOCIETY, at 8 —F Challenger, L Klein, and T K Walker The Production of Kojic Acid from Pentoses by *Aspergillus Oryzæ* —Prof T M Lowry and G Jessop The Properties of the Chlorides of Sulphur Part II Molecular Extinction coefficients —M S Lesslie and E E Turner The Isomerism of Derivatives of 2-phenylnaphthylene-1 3-diamine —Prof T M Lowry and F L Gilbert Studies of Valency Part XIII Further Experiments on the Molecular Structure and Configuration of the Quadrivalent Derivatives of Tellurium

FRIDAY, JUNE 7

GENETICAL SOCIETY (at Linnean Society) (Annual General Meeting), at 3 —Prof D E Lancefield The Genetics of *Drosophila obscura* —Dr C Stern Some Recent Work on *Drosophila*

PHILOLOGICAL SOCIETY (at University College), at 5 30 —Dr C T Onions The Supplement

GEOLOGISTS' ASSOCIATION (at University College), at 7 30 —Dr A K Wells, Dr A Brammall, and others Discussion on The Value of Petrographic Character as a Criterion of Age

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —C Leonard Woolley Excavations at Ur, 1928-29

CONFERENCES.

JUNE 5 TO 8

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (at Brighton)

Wednesday, June 5, at 2 45 —W C Wallis Brighthelmstone of Early Times —Sir Arthur Smith Woodward The Willett Collection of Chalk Fossils

At 8 —Sir Arthur Keith Southern Englishmen of the Pre-Roman and Roman Period (Presidential Address)

Thursday, June 6, at 11 A M —A H Allcroft Archæological Address —A D Cotton The Importance of the Study of Systematic Botany

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At 11 30 A M —D Edwards Town and Regional Planning

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INTERNATIONAL HIGH TENSION CONFERENCE (at Paris)

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INSTITUTION OF ELECTRICAL ENGINEERS —Summer Meeting in France

PUBLIC LECTURES.

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MONDAY, JUNE 3

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FRIDAY, JUNE 7.

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SATURDAY, JUNE 8, 1929.

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School Science.

THOSE in touch with educational circles have been aware for some time past of a growing dissatisfaction with the scope and treatment of school science The Report of the Committee of the British Association upon Science in School Certificate Examinations [1] thus comes at an opportune moment, and will be welcomed by all who realize the difficulties of the present position It is not an easy matter to probe to the root of the widespread feeling that all is not well with science in the schools, but at bottom there seems to be a conflict between utilitarian and æsthetic ideals Many teachers, recognizing that the majority of their pupils will have to work hard for a living, feel that they must be given instruction of immediate practical value, others emphasize the importance of training young people to appreciate to the full the serene joys of the intellectual life These two aims are not necessarily incompatible, and their reconciliation might be effected with reasonable ease, were not the situation rendered almost hopelessly rigid by the incubus of examinations.

There are in England and Wales eight examining bodies which conduct First and Higher School Certificate examinations, taken by boys and girls at the ages of 16 and 18, or thereabout, respectively. Through the activity of the Secondary School Examinations Council, these several examinations have been closely equated, and there is now little variation among them in syllabus and standard This uniformity is in many ways a good thing, but the disastrous result of a comprehensive yet stereotyped examination system has been to stifle originality in teaching, and to raise the list of examination successes into a fearful idol, to be at once worshipped and dreaded The effect upon science has been particularly devastating, owing to the special circumstances Science is a comparative new-comer to the school curriculum, and a mere half-century's experience has proved insufficient to enable teachers to work out the most suitable and efficient means of teaching it Yet, while still in this immature state, school science is becoming petrified by examination requirements, and the evil habit of 'cramming' is likely to establish itself firmly unless immediate steps are taken to prevent the catastrophe

The Committee not only points out the danger, but makes valuable suggestions for avoiding it. It favours a scheme whereby schools may arrange

[1] British Association Reprints No 23 Report on Science in School Certificate Examinations Pp 443-532 (London British Association, 1928.) 1*s*

their own plan of work, and examine their own pupils in association with independent boards of assessors Such a scheme is already in operation in certain technical schools, where a national certificate is awarded under the joint supervision of the Board of Education and the Institution of Mechanical Engineers; and a similar scheme has been adopted by the University of London for the examination of the twenty-two training colleges allotted to it If a system of this kind were generally adopted, with adequate safeguards, teachers would have far more freedom to elaborate methods and courses of work suited to particular needs, and school science would have the opportunity of advancing on the lines of true culture

Present conditions are responsible for a further regrettable tendency in elementary science teaching, namely, a concentration upon formal chemistry, physics, and, to a less extent—principally in girls' schools—botany Although something may be said for such a study at the stage of the Higher Certificate, it is very doubtful whether boys and girls of 14 to 16 really derive any great permanent benefit from a diluted form of academic science The 'theory' of chemistry and physics, and even of botany, is in fact not appropriate to the general education of the middle school A few bright pupils may benefit, but teachers and examiners alike realize that most of the candidates are drowned in a boundless sea of definitions, laws, and hypotheses, of a depth to them unfathomable.

Still another conspicuous defect in school science is the infrequency with which biology forms a part of the regular routine Whatever we may regard as the primary aims of teaching science to boys and girls, we must certainly include among them that of imparting an elementary knowledge of the phenomena of life. It is therefore extremely disconcerting to find that many, if not most, of our children may pass through the schools without receiving any instruction whatever in biology. There are, of course, explanations of this remarkable state of affairs. In the first place, the majority of science teachers have specialized in chemistry or physics, or both, at the universities, and are thus content, in general, to teach those subjects only; at any rate, no active demand for biological work is likely to proceed from teachers of the exact sciences unless a stimulus is applied from without Secondly, it has been—and is—maintained that biology has too recently emerged from the purely descriptive stage to lend itself to the inculcation of scientific method, whereas chemistry and physics may be very easily adapted to this end. Lastly, we are reminded that biology is based largely upon chemistry and physics, and that logic consequently demands a study of at least the elements of the two latter sciences as a necessary preliminary to biological work It is clearly an urgent matter for the biologists to show how these difficulties can be removed

Such are the principal facts relating to the present condition of science in schools It remains to consider them in relation to the strife between æsthetic and utilitarian ideals which we believe to be the real cause of the prevailing controversy Since modern civilization depends for its very existence upon the application of scientific knowledge, no one will deny the importance of teaching young citizens a modicum of scientific facts Moreover, technical occupations absorb increasingly large numbers of workers, and must continue to do so as long as civilization persists it may thus be of direct practical and financial value to a boy or girl to get elementary technical instruction at as early an age as possible These two points are, in brief, the arguments of the utilitarian school, and they undoubtedly have much weight If they carry the day, they will tend to preserve the existing scheme of formal chemistry and physics, and to exclude biology until biological callings have increased to such an extent as to offer wide and immediate prospects

Even those teachers, however, who most strongly urge the utilitarian aims agree that science, as part of a general education, should do more than impart useful information There is, in fact, an almost universal feeling that the æsthetic side of science is ultimately the most vital, but opinions differ as to the degree and manner in which this aspect is to be emphasized Stern disciplinarians, who themselves experience an austerity of pleasure in fundamental scientific philosophy, make superhuman efforts to transmit some shadow of this pleasure to restive school certificate sets, the rare occasions on which their labour gets the full appreciation it deserves are a sufficient recompense for many failures It is a commonplace that such teachers are usually regarded with no little reverence by their pupils in after years, but the reverence is rather for the man than for his teaching

There are, again, those teachers who strive 'to make science easy', and in doing so run dangerously near the borderline of insipidity · scientific facts, as such, are of no greater educational worth than the date of Waterloo or the names of Henry VIII's wives To know how an electric bell works is not necessarily to be educated It is seductively

attractive to make one's science course a series of superficial explanations of devices and phenomena, and to imagine that one is revealing the beauties of science

This has been the chief criticism levelled at 'everyday science', 'science for all', or 'general science', but it is a criticism easily disposed of, since it rests upon a misunderstanding The advocates of 'general science' have been envisaged as those who would replace the very real (if limited) benefits of formal science by the illusory returns of a shallow smattering Nothing could be farther from the truth 'General science', as properly interpreted by the Committee, is an attempt to make children see science steadily and to see it whole, to enable them to assimilate scientific principles and scientific method by a consideration of phenomena from the point of view of every relevant branch of science, and to increase their capacity for intellectual pleasure by opening to them the inexhaustible treasures which science discovers in the world of everyday life The 'general scientists', in fact, are thorough-going supporters of the æsthetic aim, though sometimes they disguise their real sentiments by pointing out the immediate practical value which the course they suggest may possess. It is true that a scheme of 'general science' may include lessons on severely practical topics, but the whole spirit of the course is to relegate the purely utilitarian aim to a definitely lower place

Unfortunately, 'general science' has to fear two extremely serious perils. The first is that it can so easily be transformed into a grotesque caricature, becoming, indeed, the smattering which it strives to avoid. The second is that it is incomparably more difficult to teach than the formal chemistry or physics or botany at present in vogue If it is to achieve its purpose, the first essential is to dispel the notion that 'general science' is a soft option, to be welcomed for the sake of weaker candidates, but otherwise to be disparaged This difficulty in teaching will, we fear, be very troublesome to overcome, but examining bodies may do something by encouraging schools to take general science, and by allowing a wide choice of questions in the papers.

Specialization at the later stage, that of the Higher Certificate, is probably inevitable. Yet we admit surprise at the qualified blessing which the Committee gives to the Higher Certificate Examination, for we cannot bring ourselves to believe that it is good for boys and girls of 16-18 to devote three-quarters of their school time to the study of only two or three special subjects. We should like to see a broader basis for the examination, with a less intensive treatment. Similar remarks apply to the university scholarship examinations, which demand what is practically degree knowledge from the candidates, and do more to sophisticate adolescent education than any other single factor

E J. Holmyard.

The Place of Science in our View of History.

The History of British Civilization By Dr. Esmè Wingfield-Stratford. Vol 1 Pp xv + 574. Vol 2 Pp viii + 575-1332 (London George Routledge and Sons, Ltd., New York Harcourt, Brace and Co., Inc, 1928) 42*s*. net.

On several occasions the pages of Nature have afforded evidence of the growing importance taken by science in the writing and teaching of history It is, in fact, at the root of the difficulty which was dealt with recently in one of the leading articles How to secure that our political leaders—and one might well add leaders of all other kinds—should approach their business in a scientific spirit? There are, of course, many ways by which the change will come, and is coming, but it may be doubted whether any way will affect a larger number of persons than that of infusing the ordinary teaching and view of history with some notion of the part that science has played in the process. For we all learn some history Not only at school but also in after life, so far as we do any serious reading at all, it is of a historical kind, floods of memoirs and biographies are being constantly poured out by the press

Here is the main source of intellectual influence which is playing upon the more thoughtful sections of the public, it is here that science must make its way It is therefore an interesting study—more interesting every time—to measure the space which science occupies in works of general scope, especially when they purport to talk of civilisation as a whole, and, most of all, of modern civilisation Such a book has just appeared in Mr. Wingfield-Stratford's "History of Civilization", which has had a remarkably good press and promises, if he can induce his publishers to produce a cheaper edition, to have a powerful influence in forming British opinion about its own past It has all the elements of sound popularity for an English public, a vigorous full-blooded style, a freedom of personal judgment, an absence of pedantry or the apparatus of learning, a readiness to admit national crimes and defects, and a glorious ending on the right side, with the British Commonwealth of

Nations standing for the cause of humanity, and encompassed by the greater League of all nations

It is a capital and most interesting book, well deserving its success But we are looking at it here from the special point of view of science, and in that respect it marks an advance, and yet, even perhaps more strongly, shows where the next advance must follow Some six or eight short sections out of 1300 pages are given to an account of the men of science themselves, who, except Roger Bacon, are justly appreciated, and the right place of science, in first accelerating and then controlling the Industrial Revolution, is well indicated. This is something to be thankful for, much more and in a better spirit than in the books of our youth, where we were lucky if we found Newton mentioned at all, even as Master of the Mint

It is still very inadequate, however, and we should like to make the inadequacy patent to Mr Wingfield-Stratford and any other open-minded writer of books on history by two considerations, one of a particular and the other of a general kind. To take the particular example first He gives us pages of a highly amusing and instructive kind on the progress of Mr Bernard Shaw to fame, his shameless self-advertisement, his gibes and clever plays. He does not do this on account of his socialism, for it does not appear that the author is a socialist He does it because of its personal interest and because in the end Mr Bernard Shaw did attain the notoriety at which he aimed. No doubt also it is one of the reasons why we find the book so interesting Now just at this time one of the greatest pieces of scientific construction in the history of mankind was going on, the development of the new astronomy which has given us the amazing view of the universe which fills the mind of all who have approached it with a fresh unquenchable curiosity and the profoundest admiration for its creators It happens that the two most prominent names in this army are Englishmen, Jeans and Eddington, and their work must have a lasting influence on the way we both think and act. Yet in the book before us there is not a word about it

That is one of many cases which might be quoted from a book in which the general spirit of the author is quite favourable to science. If these things are done in the green tree—— ? The general criticism connected with this is more intangible and may not carry conviction so readily to every mind This book, and most surveys of modern history, end on a note of poignant resignation, not of despair but of horror and uneasiness, of hope against hope We believe this tone to be largely due to the divorce of the literary mind from science. The literary mind being personal, sensitive, and often ephemeral, is naturally obsessed by the suffering and tragic conflicts of the War It is right that we should have these things brought prominently before us. A heartless science would be worse than untutored savagery But it is essential that those who aim at putting forward a general view of human progress, which is what a 'history of civilisation' must mean, should have regard to the dominant and lasting factors.

On this view, what is the most striking fact about the world towards the end of the nineteenth century and the beginning of the twentieth, above all in the throes of the War ? Surely its stability in spite of conflict, its recovery in spite of stupendous loss Were a stranger from Mars to visit this planet without a knowledge of what we have gone through in the last fifteen years, he would not report a scene of desolation or decadent idleness or internecine strife, but a hive of industry, a network of intercourse, a fertility of invention, and a range of thought which, on inquiry, would appear far to exceed anything in the human record. The black spots, such as parts of China and Russia, would also on inquiry be found to be precisely those places where the organisation, provoked and carried out by scientific thinking, were the least developed.

It is curious that this, which will certainly be the most commonplace observation about twentieth century civilisation by the historians of the future, is at present so rarely made It is due no doubt to the political and still more the literary preoccupation of the bulk of contemporary historians The League of Nations is gradually but with difficulty fighting its way into the pages of history and the everyday thinking of mankind But the foundations of the League, which lie much more in the cultural, economic, and scientific region than in the declarations of statesmen, have still to be dragged into the daylight The activities of commerce and transport, the agreements as to disease, hygiene, slavery, and the like, above all the supreme constructions of the mind, such as the new cosmogony instanced above, are all international and—in the broad sense—scientific, and, until the historians come to their work with a mind awake and to some extent instructed on this side, justice will not be done to the most vital aspects of the modern world Above all books, a 'history of civilisation' should give due place to these things, for what is modern civilisation if we leave out science ?

F. S Marvin.

Statistical Mechanics.

Statistical Mechanics. the Theory of the Properties of Matter in Equilibrium Based on an Essay awarded the Adams Prize in the University of Cambridge, 1923–24 By R H Fowler Pp viii + 570 (Cambridge: At the University Press, 1929) 35*s*. net.

THE motion of a given conservative dynamical system is a problem which can be reduced to the consideration of the properties of the functions defined by its Hamiltonian equations of motion. These equations are themselves deduced by allowing infinitesimal departures of the system from its actual course In an endeavour to base the laws of thermodynamics on mechanical grounds, Maxwell, Boltzmann, and Clausius were led to consider assemblies of similar systems, each possessing its own configuration and velocities Even were it possible to describe minutely the configuration at a given time of each member of an assembly consisting of a large number of such systems, it is doubtful whether our senses would be acute enough to appreciate the implications of such a description.

There is, however, another direction in which such inquiries may be pursued, namely, in an investigation of the law of distribution at a given instant of all the systems among the various possible configurations and velocities. The number of systems which fall within given infinitesimal limits of configuration and velocity will in general depend not only on the generalised co-ordinates and momenta, but also on the time. Where this dependence does not involve the time, we have statistical equilibrium. The problem which is now of paramount interest is the search for the normal or time-average properties of such an assembly. The only method of finding these averages which is amenable to exact treatment appears to be an identification of them with averages taken over the accessible phase-space of many dimensions by means of which the configuration and velocities of the assembly may be described

The average value of statistical mechanics may be regarded, as indeed they were by Boltzmann, Gibbs, and Planck, as values of maximum frequency of occurrence. Mr R. H. Fowler prefers to obtain them by assigning 'weights' rather than probabilities, a method which leads to a more rigorous mathematical treatment. As the immediate object is to treat statistical problems from the point of view of the classical quantum theory, this theory is regarded as fundamental, and classical systems are introduced as the limit, for large quantum numbers, of quantised systems This unusual procedure is justified by the remark that the laws of quantised systems cannot be obtained from those of classical systems The rules for assigning weights and the definition of normal properties as averages over the accessible phase-space are of course the crux of the whole matter, they may even be looked upon as a postulation of the solution. No attempt is made to disguise this logical hiatus, and it would seem that some such gap must always arise in the application of a mathematical theory to the physical world It is, indeed, an advantage that the crucial assumptions should not appear in a more subtle way

The rules for weighting are as follows:

(i) To each element of phase-space of a classical system is attached a weight proportional to its extension, namely,

$$(dp_1 \ . \ . \ . \ dq_s)/h^s.$$

(ii) To each mechanically possible stationary state of a non-degenerate quantised system is attached a weight unity.

(iii) To each state of a degenerate system is attached a weight equal to the number of different stationary states of some non-degenerate system which coalesce under adiabatic transformation in the limit to form the given state of the degenerate system.

No general proof has been given that the weight of a degenerate system so defined is unique, nor is a general rule available for counting the non-degenerate states This can scarcely be called a defect of the method, but is rather a limitation on our present state of knowledge. These weights are adiabatic invariants in the sense of Boltzmann. A simple example of an adiabatic invariant was given by Einstein in 1911, namely, the ratio of the mean kinetic energy of a simple pendulum to its period when the string of the pendulum is shortened infinitely slowly.

Having arranged a system of weighting, the next step is to calculate average values. This is done by constructing partition functions, which in the simplest cases are power series, the coefficients of which are the weights. The average values are expressed as contour integrals involving these partition functions, and these integrals are then evalued by the method of steepest descents. This is an extremely elegant and powerful mode of attack, and it is significant that the parameter ϑ which presents itself in the application of the

method can be interpreted as a function of the absolute temperature T, the actual relation being $\vartheta = e^{-1/kT}$, where k is Boltzmann's constant Gibbs considered assemblies of classical systems canonically distributed in phase, that is, those in which the index of probability is a linear function of the energy and containing a 'modulus of distribution' analogous to the temperature. The partition functions are the generalisation for quantised systems of the phase integrals of Gibbs.

After applying the above considerations to obtaining the statistical distribution laws of perfect gases, crystals, radiation, etc, the relation of thermodynamics to the equilibrium theory of statistical mechanics is established by showing that thermodynamical laws are true for the assemblies considered. An extremely interesting and searching criticism is given of the method originated by Boltzmann and extended by Planck of introducing entropy by relating it to probability, a method which is claimed to be "obscure or misleading and certainly unnecessary". The author's argument is cogent and deserves to be read with care, but it is certainly surprising that the method has passed so long unchallenged.

From this point the theory is developed in numerous aspects, Nernst's Heat Theorem, imperfect gases, thermionics, stellar interiors, to mention a few of the topics treated. Dr Lennard-Jones has contributed an interesting numerical survey of intermolecular forces The author's object has been throughout to develop a consistent theory completely, and this object has certainly been achieved. The bearing of the new mechanics has been summarised in the last chapter, the important result being found that the accessible phase-space of the classical theory must be cut down to states appertaining to a selected group of wave-functions

The leading comprehensive treatise in English on the statistical mechanics of an assembly of classical conservative dynamical systems is that of J. W Gibbs, published in 1902 Since that date mechanical ideas have travelled far, and in the light of the new mechanics we have now to talk of a classical quantum theory. Mr. Fowler has written a worthy successor to the work of Gibbs, and it is to be hoped that, when the time is ripe, it will be followed by a treatise based entirely on the new mechanics Until that time arrives the present volume must remain the most authoritative source of information on the subject as a whole.

L. M. MILNE-THOMSON

Statistics in Biological Research.

Statistical Methods for Research Workers. By Dr R. A Fisher (Biological Monographs and Manuals, No 5.) Second edition, revised and enlarged. Pp xii + 269. (Edinburgh and London · Oliver and Boyd, 1928) 15*s* net.

WITH the increasing application of statistical methods to new fields of work, the problem of the handling of small samples has become more and more important It is true that the larger the sample the more trustworthy are the inferences which can be drawn from it, but there are certain problems, whether biological or industrial, in which the time and cost involved in obtaining even a moderately large sample would be quite prohibitive This need for a development of small sample theory has emphasised the importance of placing the methods of inference on a clearly defined and logical basis For loose thinking and careless interpretation are both easier and more dangerous when dealing with small than with large samples The aim of the statistician must be to bring the simplifying assumptions of theoretical analysis into correspondence with the varied and complex situations of practical work.

Dr. Fisher sets out in the introduction to this book, of which a second edition has been published recently, what may be termed his statistical philosophy It may not perhaps be easy to follow at a first reading—perhaps not before his mathematical papers published elsewhere have been read and if necessary interpreted in more familiar terms—but a grasp of the ideas involved is essential to a clear understanding of his methods. These are perhaps, after all, more like those criticised than he will allow, but the line of approach is somewhat different His aim has been to develop on systematic lines a series of tests appropriate for use in a great variety of problems This has involved a very considerable extension of theory, based in several cases upon a most elegant use of the geometry of multiple space. These proofs are not, of course, given in the present book, which is primarily intended for biological research workers, but the practical applications of the methods to a variety of problems are given with numerical illustrations, and the necessary probability tables

To discuss how far the author has achieved his object of putting clearly before the research worker the means of applying statistical tests, would require perhaps a reviewer who is a non-mathematical biologist. There is one criticism, however, which must be made from the statistical point of

view. A large number of the tests developed are based upon the assumption that the population sampled is of 'normal' form That this is the case may be gathered from a very careful reading of the text, but the point is not sufficiently emphasised It does not appear reasonable to lay stress on the 'exactness' of tests, when no means whatever are given of appreciating how rapidly they become inexact as the population sampled diverges from normality That the tests, for example, connected with the analysis of variance are far more dependent on normality than those involving 'Student's' z (or t) distribution is almost certain, but no clear indication of the need for caution in their application is given to the worker It would seem wiser in the long run, even in a text-book, to admit the incompleteness of theory in this direction, rather than risk giving the reader the impression that the solution of all his problems has been achieved The author's contributions to the development of 'normal' theory will stand by themselves, both for their direct practical value and as an important preliminary to the wider extension of theory, without any suggestion of undue completeness

A last chapter on the principles of statistical estimation has been added to this edition. It provides a good illustration of the application of the ideas contained in the introduction and elsewhere, although perhaps it may prove stiff reading for the biologist

Our Bookshelf.

The Works of Aristotle. Translated into English under the Editorship of Dr. W. D. Ross Vol. 1 · *Categoriæ and De Interpretatione*, by E. M. Edghill, *Analytica Priora*, by A. J. Jenkinson; *Analytica Posteriora*, by G R. G. Mure; *Topica and De Sophisticis Elenchis*, by W. A Pickard-Cambridge Pp iv + 652 (Oxford: Clarendon Press, London. Oxford University Press, 1928.) 15*s* net

THIS substantial volume is the first of a series to be added to the well-known Oxford translations, which is to include the whole of the extant works of Aristotle. The six treatises of which this book consists constitute Aristotle's immense contribution to what became known later as the science of logic. The translation faithfully reflects the nature of that contribution

One might gather from the statements made in many a compendium of the history of philosophy that Aristotle worked out a systematic treatment of logical science This is not the case All the same, he was the real founder of logic as a distinctive discipline, and it was he who made the wonderful discovery of the nature of syllogistic inference. His work is set forth in this translation in a manner which will not only satisfy the scholar, but will also make it accessible to educated readers who cannot pretend to be scholars. The four contributors to the volume have worked under the general editorship of Dr. W. D. Ross, whose guidance and inspiration each of them in turn gratefully acknowledges.

The Statesman's Year-Book · Statistical and Historical Annual of the States of the World for the Year 1929. Edited by Dr M Epstein. Sixty-sixth Annual Publication. Revised after Official Returns Pp. xxxii + 1448. (London: Macmillan and Co, Ltd, 1929) 20*s* net

THIS valuable year-book has again undergone a thorough revision and incorporates the latest official statistics up to the time of going to press. The lists of books of reference have also been revised Notable events have occurred in many States during the year, such as the establishment of a central government with new capital in China, the transformation of Albania from a republic to a monarchy, and the restoration of the temporal sovereignty of the Pope These and other events are duly noted, but the list of separate States now remains the same, and there have been few territorial readjustments during the year The introductory tables include several of world production of selected commodities In one respect the value of the book could be enhanced that is, by the inclusion year by year of more tables of this kind. There is the usual section on the League of Nations. The coloured maps show the City of the Vatican (on a large scale) and the Peru-Colombia boundary adjustment The size of the book has been slightly reduced, mainly by the condensation of the index, which does not, however, impair its value

The Annual Register a Review of Public Events at Home and Abroad for the Year 1928. Edited by Dr. M Epstein Pp. xiv + 316 + 166. (London, New York and Toronto. Longmans, Green and Co., Ltd., 1929.) 30*s*. net.

THIS well-known work of reference has now reached its hundred and seventieth volume, a length of life which alone expresses its value It continues on the lines of previous issues The first part, consisting of about 300 pages, is a survey of the history of the world during the year As usual, this survey is conspicuous for its completeness and lucidity Nothing of importance seems to be omitted In the second part of the book there are a chronicle of events which do not fall within the scope of the historical survey, and obituary of some hundred or more eminent men of all nations. The retrospect of achievements during the year devotes nine pages to a record of science, which is little enough compared with literature and finance, but the scientific chapter is nevertheless an excellent survey of the year's progress The public documents given in full this year are the Kellogg Pact, the Convention of the Pan-American Union, the Agreement with Transjordania, and the Anglo-Chinese Treaty.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

New Evidence of the Action of Sunlight on Aurora Rays.

ON Mar. 15 last I received information from the State Telegraphic Department that earth currents were disturbing the telegraphic service Believing that we should have an aurora in the evening, I warned my four photographic stations, Oslo, Kongsberg, Tomte, and Oscarsborg, to be ready for action immediately after sunset. Using the excellent type of direct vision spectroscope described by Lord Rayleigh,[1] I was able to localise an aurora arc in the northern sky during the twilight, long before it was possible to distinguish it visually.

The photographic work began as soon as the sky had become dark enough, and a long series of photograms were taken simultaneously from two, three, or four stations during the whole night; among these are 14 quite successful ones from two stations, 38 from three stations, and 12 from four stations I led the work from my station Oslo, but was obliged to go home about midnight G.M.T. Before going away I asked my excellent collaborators, Wesoe and Tveter, to continue until the dawn and keep a good look-out for sunlit aurora rays, which might probably appear in the late hours of the night Their perseverance was richly rewarded At 2 h 40 m G.M.T , three hours before sunrise, there suddenly appeared in the north-east long bluish pale aurora rays which developed

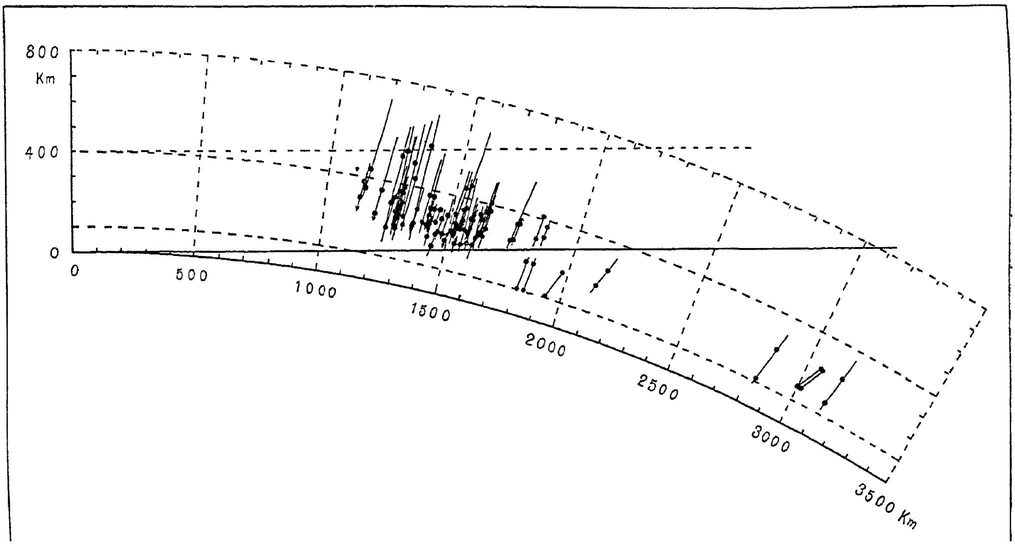
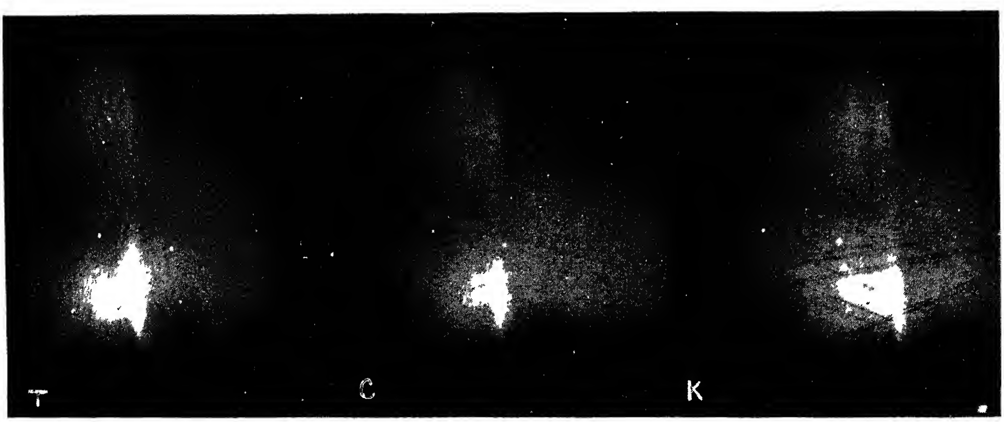


FIG. 1.



TÖMTE OSLO. KONGSBERG

FIG 2 —Photographs of aurora taken simultaneously at the places indicated under them

[1] "On Visual Observations of the Aurora Line in the Spectrum of the Sky at Night", *Gerlands Beitrage zur Geophysik*, vol 19, pp 292-297.

westwards and continued until 3 h 30 m. G.M.T. Meanwhile, at the station Oscarsborg, where Hafnor was working, the sky had become overcast, but the other three stations were now taking simultaneous photographs as fast as possible one after another, and a large number of successful photograms were secured. At Oslo the photographs were taken by Tveter, at Kongsberg by Busengdal junior, and at Tomte by the Antarctic explorer Carsten Borchgrevink.

The measurement and calculation of those sunlit aurora rays have been made by my assistant Wesoe and myself, and their position relatively to the earth's shadow calculated. Also the other not-sunlit aurora rays of the same night have been treated in the same manner

On the accompanying diagram (Fig 1) is seen the position of all the rays of the night of Mar. 15–16 compared with the position of the earth's shadow. The figure represents a vertical section of the earth, and the tangent to the earth's surface is the boundary between the sunlit and dark atmosphere For each point of an aurora ray the position in the vertical plane through the centre of the earth and the sun is marked by a small circle On each aurora ray two points are calculated and combined with a straight line representing the ray. This line is continued beyond the points as far as the photographs indicate. If the ray passes out of the photographic field it is marked by an arrow, and if the foot or summit can be seen on the photograph no arrow is given

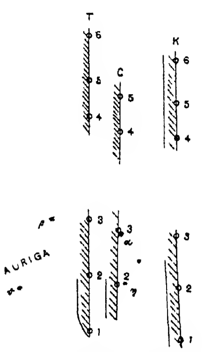


FIG. 3 —The rays as seen from Kongsberg, Oslo, and Tomte are marked by the letters K, C, and T Corresponding points have the same number

The high rays were all lying in sunshine, and their lowest points, which have been measured with great care, are situated near the boundary between sunlit and dark atmosphere. Some of the rays have their summits nearly 700 kilometres above the earth, and all lie far to the north, some even in the zenith of Tromso and northern Finland The measurements are particularly trustworthy on account of the long base-lines, 46 68 km from Oslo to Tomte, 65 70 km. from Oslo to Kongsberg, and 105 14 km from Kongsberg to Tomte. The results have further been controlled by calculating the height in choosing either Oslo — Tomte, Oslo — Kongsberg, or Kongsberg—Tomte as base-lines

In contrast to these high rays, lower rays are seen to the right on the same diagram; they lie in the dark part of the atmosphere. Thus some of the same general features are seen here as on the diagram published in my communication to NATURE of Jan 19, 1929. A new and extremely interesting phenomenon was, however, observed with certainty on that night for the first time. Some of the rays consisted of two luminous parts, one situated in sunlight and another in darkness and connected by an invisible part, stretching from the boundary of the sunlight and downwards. These rays are indicated on Fig. 1, the invisible part being dotted. On Fig. 2 are seen the photographs of the rays at 3 h. 16 m 29s. G M T.

The constellation Auriga with the star Capella are clearly seen on the photographs. A sketch of the situations of the principal ray is seen on Fig. 3. On the right border we have chosen the corresponding points 1, 2, 3, 4, 5, 6, and with the different base-lines the following heights were found in km .

Base-line	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
Oslo-Tomte		161	202	314	363	
Oslo-Kongsberg		151	211	323	368	
Kongsberg-Tomte	100	157	214	316	361	409

The lowest point of the upper part was found to be at about 296 km and the highest point of the lower part to be at about 223 km. above the earth's surface; calculating the height of the boundary between sunlit and dark atmosphere at the situation of the ray, we found it to be 275 km

Thus the bundle of corpuscular rays causing the aurora ray at first illuminates the upper sunlit atmosphere; then the illumination ceases at the beginning of the dark atmosphere but begins again lower down, when the density of the air is great enough to excite luminosity. The action of sunlight may be a direct one, as mentioned in my former note, or an indirect one in forming a tail which becomes luminous where it is penetrated by the bundle of corpuscular rays

CARL STÖRMER.

Oslo.

A Property of Superconducting Metals.

IN a recent article by Kapitza (*Proc Roy. Soc* , A, **123**, 342; 1929) it is suggested that (1) superconductivity is a general phenomenon, which can exist in all metals, but (2) is "masked by an additional resistance which does not disappear in most metals at low temperatures". This additional resistance is supposed to be due to "structural and chemical imperfections of the metal". Regarding (1), it appears that the superconductors have a peculiar hitherto unnoticed property, which will be presented in more detail below. Because of this, I am inclined to believe that (1) is incorrect (to all practical purposes), and that one could with equal right say that ferromagnetism is capable of existing in all metals, but is masked by other effects in some. As to (2), it would seem that, since the conductivity in the superconducting state is of an entirely different order of magnitude from that of the conductivity of any normal metal, the additional resistance disappears owing to the short-circuiting, by the pure superconductor, of the impurity or structural imperfection. In the system non-superconductor + impurity, the two resistances are not of such greatly different orders of magnitude, and so the impurity may have a quite marked effect on the resistance.

If one plots relative resistance against temperature, for the various metals (excluding bismuth), with the aid of the tables given by Onnes and Tuyn (*Comm.*, Leyden, Supp No. 58), then the curve is as follows: (1) At low T, for non-superconductors, approximately horizontal, with a finite intercept on the resistance axis, (2) at higher T, convex toward the temperature axis, and (3) at still higher T, linear in T over a large range of temperature. In an analogous fashion to Kapitza's, one can extrapolate the two linear parts (1) and (3) to intersection, and obtain a 'critical temperature'. When one plots this critical temperature against atomic number, the curve resembles somewhat that of the plot of the Debye characteristic temperature Θ against atomic number, although the connexion, if any, subsisting between these two temperatures is by no means obvious. The striking fact that is observed is that in the case of superconductors, including the newly discovered ones, tantalum and thorium, the critical temperature lies quite low, and probably lower than in the case of non-superconductors. That is, the temperature coefficient of

relative resistance for part (3) of the curve is more nearly $\frac{1}{273}$ for the superconductors than for the other metals For the same part of the curve, at any given temperature, that metal is most likely to become a superconductor which has the greatest relative resistance. One cannot say that every superconductor has a low characteristic temperature, that of tantalum being at 243° K (F. Simon, *Zeits f. Phys Chem.*, **129**, 334; 1927). No superconductor as yet discovered has, however, a high critical temperature, and this fact seems to be more than a chance coincidence.

A superconductivity model which gives a qualitative picture of most of the facts is easily set up. One may think of a crystal as composed of two systems interacting with each other, namely, (1) the lattice with its characteristic vibrations and (2) the electron system, considering the lattice ions at rest In case (2), which includes electronic interaction, one may, theoretically, solve a Schrodinger equation and obtain eigenvalues and eigenfunctions. The system (1) may then be considered as a perturbation acting on (2). One can assume that, in the superconducting state, the lattice has not sufficient energy to impart it in the form of kinetic energy to the electrons, but that the latter may only change their magnetic energy Probably, also, there is no net exchange of momentum between electrons and lattice. There subsist, then, no inelastic collisions and no elastic collisions with loss of momentum, so that no resistance can enter.

As to the influence of the magnetic field and its parallelism with that of the temperature, one can be guided by the Heisenberg picture of ferromagnetism At $T=0$, in a vanishingly weak external magnetic field, the elementary magnets (electron spins) all point in the same direction. If energy is imparted to the system, either because of an external field being applied, or the temperature being increased, then some spins will now be 'antiparallel'. It is assumed that the first excited kinetic energy level lies quite high for the superconductors, so that the magnetic energy cannot be converted into kinetic energy. This marks the essential difference between superconductivity and ferromagnetism, as in the latter case the kinetic energy levels lie so close together (probably) that magnetic energy may be converted readily into kinetic energy and the system will come to equilibrium when as many spins as possible are parallel (consistent with the temperature agitation), while in the former case such a balancing between spins and temperature agitation is not possible

This picture is advanced only tentatively, to account for the sharpness of the transition temperature and the parallel effects of magnetic field and temperature Whether it is right or not will only be known when it becomes possible to correlate, at least qualitatively, the value of the transition temperature with other properties of the metal, and to explain the connexion of superconductivity with the character of the resistance curve. JAMES H. BARTLETT, jun.

Zurich, April 27.

MR. BARTLETT brings up in his letter a very interesting view to explain the disappearance of the residual resistance at the threshold temperature in supraconductors. As this residual resistance is produced by impurities or structural imperfections, it is suggested that it can be short-circuited by the perfect (healthy) paths of the conducting metal, which suddenly acquire an abnormally high conductivity of quite a different order from that observed in ordinary metals.

This picture, however attractive it is at first glance, presents some difficulty on comparison with experimental data. If we take, for example, the measurement by Meissner of the resistance (*Phys Zeit.*, p. 725; 1926) of very good crystals of gold, cadmium, and zinc, in which the residual resistance is many times smaller than in ordinary wires, this makes it possible to estimate the value of the ideal resistance at a low temperature more accurately, and it appears that at 4 2° K. the ideal resistance cannot be of a greater order than 10^{-6} of that observed at 273° K., and if we extrapolate the ideal resistance to 1 3° K., we find it to be less than 10^{-7} or 10^{-8}. Only the upper limit can be fixed from present experiments, and the actual ideal resistance may be any number of times smaller This order for the upper limit of resistance corresponds to that fixed by present measurements for all supraconductors (except lead, where it was proved to be less than 10^{-12}) Thus there is no experimental evidence "that the supraconductive resistance is of any entirely different order" from the ideal resistance of a metal at a correspondingly low temperature.

According to Mr. Bartlett's view, this low ideal resistance of the healthy spot of the crystal must short-circuit the bad spots which contribute the additional resistance even for non-supraconductors, and this does not agree with experimental evidence, for most of the metals the additional resistance remains practically constant in the range of the lowest temperature On the other hand, McLellan, Niven, and Wilhelm (*Phil Mag*, p. 678; 1928) find that although 2 per cent of cadmium added to lead increases very much the residual resistance, the lead still remains a supraconductor In this case it seems to me there is very little room left for the healthy undisturbed crystal lattice, as in a line of atoms, on an average a cadmium atom will be separated by only 3 or 4 atoms of lead

The sketch of the theory of Mr. Bartlett is very interesting, and it will be most important to see it worked out and tested by experiment It seems to me that at present the greatest difficulty which meets any theory of supraconductivity is to account, not for the high value of the conductivity, but for the suddenness of the phenomenon. This is especially difficult, since the experiments definitely indicate that no structural or thermal phenomenon occurs at the threshold temperature, and I fail to see how Mr. Bartlett accounts in his theory for the suddenness of the appearance of supraconductivity. In any event it is evident that, according to his views, the mechanism of supraconductivity must take place in the healthy paths of the metal, and we must expect that the threshold temperature will be independent of the kind of impurity and a constant for any given supraconductor. This does not seem to be strictly the case; for example, in indium in different specimens the threshold temperature was found to be different (Tuyn and Kamerlingh Onnes, *Com.*, Leyden, No. 167*a*, p 6)

On my view, which was supported by the evidence obtained in experiments on change of resistance in magnetic fields, the phenomenon of supraconductivity is accounted for by the sudden disappearance of the disturbances produced by imperfections in the metal which are the reason for the additional resistance. The advantage of this view is, first, that as the change must take place only in local spots in the metal, no change in the general state of the metal will be required as actually observed (possibly, if the impurities amount to several per cent, such a change may be experimentally traced). Secondly, we should expect that the threshold temperature would vary with different impurities introduced in the metal. It is evident that on this suggestion it is practically inevitable that all metals at low temperatures will become supraconductors, if the influence of the impurity can be eliminated. I do

not think that there is any experimental evidence that the supraconducting metals form a separate group of elements like the ferromagnetic group or are exceptional in some other ways We find the supraconducting metals in four groups of the periodic table They have either a cubic or most irregular lattice, some of them belong to the transition group of elements, and we have amongst them the metals of the highest and lowest melting point All the special relations between resistance and temperature for supraconductors pointed out by Mr Bartlett are found by a more minute analysis of experimental data to apply also to some non-supraconductors The special significance which Mr. Bartlett attaches without any theoretical justification to the fact that all supraconductors have a characteristic temperature below 243° *K*, probably is no more significant than the fact that the atomic weight of every supraconductor is higher than the 115 of indium, because this happens to be the lightest supraconductor.

Finally, the very important recent discovery made by de Haas (NATURE, Jan 26, p 130) that the eutectic alloy of gold and bismuth can become a supraconductor, must be considered very carefully. The details of the experiment are not yet known, but from the point of view which I am defending, the explanation of the phenomenon may be that in a mixture of gold and bismuth one of the metals absorbs more readily the impurities of the other, and this purification may be of such a nature that it allows one of the components to become a supraconductor

All these considerations, no doubt, cannot be regarded as final proof of my suggestion, but they offer a definite application of the hypothesis and give a quite fresh experimental line of attacking the problem of supraconductivity

P. KAPITZA.

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(Magnetic Laboratory),
Cambridge.

Mass and Size of Protein Molecules.

BY means of a method which utilises the measurement of sedimentation equilibrium and sedimentation velocity in strong centrifugal fields at constant temperature, a systematic study of the mass and size properties of the molecules of various proteins has been carried out in this laboratory during the last five years. Our work has been rewarded by the discovery of a most unexpected and striking general relationship between the mass of the molecules of different proteins and the mass of the molecules of the same protein at different acidities, as well as of a relationship concerning the size and shape of the protein molecules

It has been found that all stable native proteins so far studied can with regard to molecular mass be divided into two large groups the hæmocyanins with molecular weights of the order of millions and all other proteins with molecular weights from about 35,000 to about 210,000. Of the group of the hæmocyanins only two representatives, the hæmocyanin from the blood of *Helix pomatia* with a spherical molecule of weight 5,000,000 and a radius of 12 0 $\mu\mu$, and the hæmocyanin from the blood of *Limulus polyphemus* with a non-spherical molecule of weight 2,000,000, have been studied so far

The proteins with molecular weights ranging from about 35,000 to 210,000 can, with regard to molecular weight, be divided into four sub-groups. The molecular mass, size, and shape are about the same for all proteins within such a sub-group. The molecular masses characteristic of the three higher sub-groups are—as a first approximation—derived from the molecular mass of the first sub-group by multiplying by the integers *two, three,* and *six.* The molecules of the first and fourth sub-group are spherical, with a radius of 2·2 $\mu\mu$ and 4·0 $\mu\mu$ respectively, while the molecules of the second and third sub-group are non-spherical. Ovalbumin and Bence-Jones's protein belong to the first sub-group, hæmoglobin and serumalbumin belong to the second sub-group, serum globulin belongs to the third sub-group, Rhodophyceæ-phycocyan, Cyanophyceæ-phycocyan, Rhodophyceæ-phycoerythrin, edestin, excelsin, amandin belong to the fourth sub-group in the neighbourhood of their isoelectric points.

The molecules of most of the proteins of the fourth sub-group are easily disaggregated with increasing *p*H. Thus R-phycocyan at a *p*H of 4·6 belongs to the fourth sub-group, but at a *p*H of 6 8 belongs to the third sub-group, that is, its molecules are disaggregated into halves and have lost their spherical symmetry. C-phycocyan at a *p*H of 4·6 belongs to the fourth sub-group, but at a *p*H of 6·8 about one-third of its molecules are disaggregated into halves, at the same time losing their spherical symmetry; at a *p*H of 12 0 the molecules of this protein are probably all reduced to the mass and shape of the protein molecules of the first sub-group, thus regaining their spherical symmetry R-phycoerythrin at a *p*H of 4·6 belongs to the fourth sub-group, but at a *p*H of 11·0 about one-fourth of its molecules are reduced to the first sub-group. Edestin belongs to the fourth sub-group from its isoelectric point *p*H 5·5 to about *p*H 10. At a *p*H of 11 3 a considerable amount of molecules belonging to the second and third sub-group are present, together with the normal molecules belonging to the fourth sub-group

Although not more than 11 different proteins belonging to the group which displays these regularities have as yet been studied, it would seem very improbable that the relationship between the molecular masses and sizes were incidental. Perhaps the most striking proof of the close relations between the different proteins is the fact that one and the same protein may, according to the *p*H to which it is brought, appear with the molecular mass, size, and shape of another protein.

When looking for an explanation of these unexpected regularities, it would be well to bear in mind the fact already brought out by many bio-chemical experiences, namely, that Nature in the production of organic substance within the living cell seems to work only along a very limited number of main lines. The great variety appears in the specialisation of details. Thus it would seem that the numerous proteins are all built up according to some general plan which secures for them only a very limited number of different molecular masses and sizes when present in aqueous solution. By varying the constituents of the different proteins (different percentage of different amino-acids, etc) the chemical and electro-chemical properties may be varied sufficiently to enable the cells to make use of them for their different purposes

The experimental data upon which the above conclusions are based have to a large extent been published in the *Journal of the American Chemical Society.* Part of the material is unpublished. The investigations have been carried out in co-operation with R. Fåhraeus, J. B. Nichols, N. B Lewis, E. Chirnoaga, F. Heyroth, B. Sjogren, T. Katsurai, A. J. Stamm.

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Rate of Decay of Polonium in Different Points of the U.S.S.R.

THE half-period of a radioactive element characterises the rapidity with which it decays. If the classical theory of the spontaneously exploding atom be accepted, this rate should be the same at any point of the earth's surface.

In order to verify this assumption, measurements of the half-period of polonium have been made during the past two years. Polonium was chosen for this purpose, as the most convenient radioactive substance for observations of this kind, because it is easily obtained in a pure state, its half-period can be directly observed (136 5 ± 0 3 days), and it is also the last radioactive member of the uranium series

In these experiments polonium was deposited electrolytically on accurately polished gilt brass discs of 75 mm. diameter to avoid the possibility of the oxidation of metallic surface. Discs having small rims were supplied with round covers which safely protected the active layer from mechanical effects. The process of carrying out the experiments was as follows: The discs were carefully measured by means of a compensating electrometric set which allowed their activity to be determined through the magnitude of the ionisation current with an accuracy of 0·2 per cent The set itself was verified by means of a uranium standard. Just after this measurement the active discs were packed, sealed up and sent by post to a number of places, where they were kept according to instructions in the Local Weights and Measures Offices, which are under the management of the Central Chamber of Weights and Measures.

After an interval of about five months, packets containing the discs were returned to Leningrad and were immediately measured for the second time The half-period was calculated according to the formula expressing the rate of decay $I_t = I_0 e^{-\lambda t}$, and to the equation $T = \log 0{\cdot}5 \times I/\lambda$ where I_0 is the initial activity before sending to the points, I_t, the activity after the receipt in Leningrad; t, the time between two measurements, λ, the radioactive constant; and e the base of natural logarithms.

The determinations of the half-periods were made at eighteen points corresponding to eighteen towns, namely, Murmansk (1), Archangelsk (2), Leningrad (3), Vologda (4), Kazan (5), Moscow (6), Samara (7), Kursk (8), Saratov (9), Charkow (10), Rostow/Don (11), Odessa (12), Astrachan (13), Krasnodar (14), Wladikaukas (15), Tiflis (16), Baku (17), Erivan (18).

The most northern point was Murmansk (68° 59′ N.) and the most southern one was Erivan in Caucasus (40° 11′ N.)

All the points were distributed through a distance of 3000 km. along the meridian. The results obtained show that the rate of decay of polonium is far from being equal in all points. The value of the period changed from 125·6 days (Tiflis) to 181·6 days (Krasnodar) A significant reduction for Astrachan gave the value 127·8 days. The average least square error of the observations did not surpass 0·7 per cent.

From the results obtained we reach the conclusion that, taking into consideration the absence of influence of the metal, which could only reduce the value of the half-period, local conditions had an influence upon the rapidity of radioactive decay.

To verify our assumption, the determinations of the half-period were repeated for all eighteen discs after they had lain about five months in Leningrad The values of the period thus found varied from 137·2 to 139 5 days, which is not outside the limits of observation errors On the accompanying diagram (Fig. 1) curve A shows the values of the half-period in different places, and curve B the values of the half-period in Leningrad.

The experiments described are preliminary only, and the investigation will be undertaken on a larger scale with the view of determining without any doubt the influence of local conditions upon the rate of decay of radioactive elements

This phenomenon can be easily explained, if we admit Perrin's theory assumption of the existence of an external source of radiant energy which produces the radioactive decay of atoms. If we admit the existence of this source in the centre of the earth,

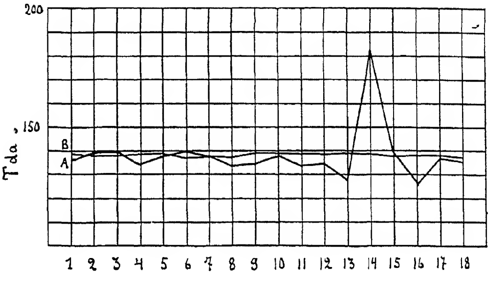

FIG 1

the rapidity of the decay must be influenced by the quantity of radioactive substance which is included in the great bulk of the basic rock. The greater the quantity, the less must be the decay in this place because of the absorption of radiant energy, causing the radioactive decay of heavy atoms, by radioactive elements in the underlying layers.

In favour of this assumption also, we have the fact that the greatest deviations of the period occur in places with disturbed tectonics, that is, in the places situated in Caucasus and the region adjoining it, on its northern boundary.

L. N. BOGOJAVLENSKY.

Central Chamber of Weights and Measures,
Leningrad, April 18.

Thyroid and Temperature in Cold-blooded Vertebrates.

THIS problem which Prof. Huxley discusses in NATURE of May 11, p. 712, is a very intriguing one. To me it appears to have more difficulties than Prof. Huxley allows for. He begins by saying that "it is well known that the thyroid is concerned with temperature regulation in homothermic animals". In my recently published book, "Fever, Heat Regulation, Climate, and the Thyroid Adrenal Apparatus", I have reviewed the very scanty and contradictory literature on this subject, and one could scarcely say that the relationship of the thyroid gland to heat regulation has been previously either well known or well understood. I dare scarcely hope that my own views on the problem as set forth in a book published only a year ago have already been assimilated so completely as to have become a commonplace of scientific literature.

In the book mentioned I directed attention to the difficulties of the problem discussed by Prof. Huxley. In warm-blooded animals a change of the thermal environment from heat to cold stimulates the thyroid and adrenal glands to increased activity, and there is a rise in general metabolism Exposure to heat produces the opposite effect: it induces a resting condition in the thyroid and adrenal glands and the metabolism is lowered. The resting condition of the

thyroid gland is indicated *inter alia* by an accumulation of colloid in the thyroid vesicles Now in cold-blooded animals exposure to cold produces a fall both in the temperature of the tissues of the animal and in the metabolism, while heat raises both. One might expect that a fall in the temperature of the animal as a whole would diminish the activity of its organs, including the thyroid gland. In that case the interesting conclusion would follow that in the course of evolution the response to an environmental stimulus in a specific group of cells has been completely reversed although the cells have not changed their specific character.

Prof. Huxley's suggestion is that the thyroid of cold-blooded animals, like that of warm-blooded animals, is stimulated by cold and inhibited by heat. This would imply that while the temperature of the animal as a whole falls and the activity of its organs diminishes, one particular organ—the thyroid gland—has a greater functional activity at a lower temperature than at a higher temperature One cannot exclude *a priori* such a possibility because it appears to be paradoxical But it requires more convincing evidence for its support than Prof. Huxley adduces from his own experiments The statement attributed to Adler that in tadpoles low temperature caused hypertrophy of the thyroid gland both in growth and functional activity is open to the criticism that in warm-blooded animals increased functional activity does not manifest itself by hypertrophy

In conclusion, it may be pointed out that the whole problem is further complicated by the fact that in warm-blooded animals the adrenal gland plays a very important part in the heat-regulating mechanism, this gland acting synergically with the thyroid gland. There is a striking parallelism between the development of the heat-regulating mechanism and the evolution of the adrenal gland as expressed in the changing anatomical relationship of the two histogenetically distinct tissues which in the mammals form cortex and medulla. This must be taken into account when differences in the heat-regulating mechanism of cold-blooded animals is being discussed

W. CRAMER.

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8-11 Queen Square, London, W.C 1,
May 13.

Variation of Latitude with the Moon's Position.

IN NATURE of Jan. 26, 1929, p. 127, Prof. H. T. Stetson has described a variation of latitude with the moon's position, and in the *Comptes rendus de l'Académie des Sciences* of July 30, 1928, A. Gougenheim has described a variation of latitude with the

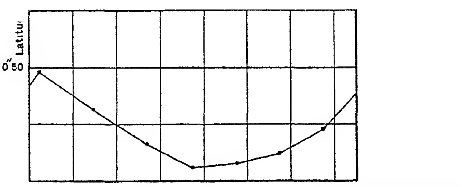

FIG 1

age of the moon. In October and November 1926 a series of observations of the latitude of Dehra Dun (India, Lat. 30° N.) were made with a prismatic astrolabe, which show a clear relation between the latitude and the age of the moon (Fig. 1), but no relation at all between latitude and moon's altitude (Fig. 2). The variation with the moon's age was about one-third of that found at Algiers, and was apparently in phase with it.

The fact that the astrolabe at Dehra Dun shows no variation with moon's altitude does not of course

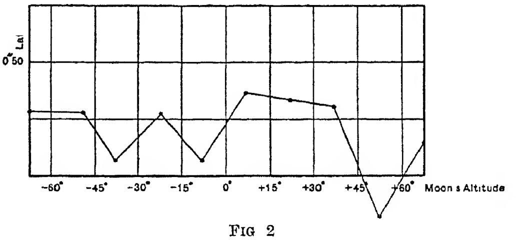

FIG 2

invalidate deductions made from Prof. Stetson's more precise and extended series, but it seems surprising that the fortnightly variation (if it truly exists) should be larger and more easily measured than the daily variation.

Each point in Fig 1 represents about 10 series of observations, each lasting about two hours and giving apparent probable errors of 0″·3.

G. BOMFORD.

Survey of India, Dehra Dun

A New Titanium Band System.

THE dominant feature of the *M*-type stars is the very extensive group of titanium oxide bands, beginning in the blue region of the spectrum and continuing far to the red. The group of bands occurring in the blue-green region has been analysed (see Christy and Birge, NATURE, **122**, 205; 1928), and shown to be due to a $^3P - {}^3P$ transition of neutral titanium oxide

Bands in the red portion have been observed by many investigators and especially by P. W. Merrill, who found that those of the λ7054-λ7700 region are particularly intense in *M*-type spectra. Twenty bands, including in all 46 heads, extending from λ7990 to λ6270, and partially overlapping the above group, have now been assigned to a new system The lower level is the same as that of the former system in the blue-green. This, and the fact that both systems appear in absorption in stellar spectra, show that the two are resonance systems The frequencies of the heads of the new system are given by

$$\left.\begin{matrix} 14172·2 \\ 14105·8 \\ 14030·8 \end{matrix}\right\} + (862·5n' - 3·84n'^2) - (1003·8n'' - 4·61n''^2)$$

with an average residual of 1 cm.$^{-1}$. As shown by the formula, the mean separation of the heads is 70·7 cm.$^{-1}$. The mean separation of the lower levels of the blue-green system was shown indirectly to be about 70 cm.$^{-1}$ (see *Phys Rev.*, May 1929), indicating that the upper level of the new system is single. Each of the three heads of the more intense bands has a clearly marked secondary head at about 10 cm.$^{-1}$ to the red. These latter heads are formed presumably by the *Q* branches. Since transitions between singlets and triplets are very uncommon in band spectra, the upper level is in all probability a ^3S.

The values of ω_0'' and $\omega_0''x''$ (that is, 1003·8 and 4·61) are believed to be somewhat more accurate than those published previously, and are based on the mean separation of levels as found from both systems. Using the new values and assuming a linear extrapolation, the heat of dissociation for the lower level is found to be 6·74 volts. The total energy resulting

from the dissociation at the other two levels is also about 7 volts. There are still a few bands in the region λ6270 to λ5600, overlapping both systems, which remain unassigned. Their general appearance is different from that of the bands in either analysed system.

ANDREW CHRISTY

University of California,
April 22

Mimicry.

THE objections to natural selection and chance variation raised by my friend Prof E. W MacBride in NATURE of May 11, are those expressed by Asa Gray and answered by Darwin, when in 1867 he sent the advanced sheets of "Variation of Animals and Plants under Domestication" to the great American botanist The creative power of natural selection is explained by a metaphor

"If an architect were to rear a noble and commodious edifice, without the use of cut stone, by selecting from the fragments at the base of a precipice wedge-formed stones for his arches, elongated stones for his lintels, and flat stones for his roof, we should admire his skill and regard him as the paramount power Now, the fragments of stone, though indispensable to the architect, bear to the edifice built by him the same relation which the fluctuating variations of organic beings bear to the varied and admirable structures ultimately acquired by their modified descendants"

Now apply Prof. MacBride's argument to Darwin's metaphor. "Why are certain stones selected? Because they are the fittest" Certainly. "How do we know that they are the fittest? Because they are selected." Obviously absurd

Again, referring to 'chance' or 'accident', Darwin wrote: "The shape of the fragments of stone at the base of our precipice may be called accidental, but this is not strictly correct, for the shape of each depends on a long sequence of events, all obeying natural laws. . . . But in regard to the use to which the fragments may be put, their shape may be strictly said to be accidental"

With regard to birds as enemies of butterflies, the necessities of space prevent me from doing more than refer Prof MacBride to the publications of the Entomological Society of London, where he will find much evidence of serious attacks as well as numerous isolated examples

In reply to Dr. Carter's interesting letter, I would point out that the behaviour of an insect-eating animal may suggest processes essentially similar to the simpler reactions of man A chameleon once stung by a honey-bee would never touch another The association and memory were perfect, after a single lesson. It must be remembered, too, that mimicry is especially characteristic of forest butterflies where the alternation of sunlight and shadow renders the imperfect resemblance of a flying insect far more effective than it would be in uniform light or shade.

EDWARD B POULTON.

Oxford, May 24

Another Species of Monœcious Oyster, *Ostrea plicata* Chemnitz.

IT was noted by me in 1926 (*Proc. Roy. Phys Soc*, vol. 21, Part 2; 1926) that the different species of *Ostrea* can be grouped into two categories, the monœcious and the diœcious I also enumerated several fundamental points of difference between them morphologically and physiologically. Later in 1928, J.H. Orton in NATURE, Mar 3, 1928, put more emphasis upon the distinction of the two categories.

There are more than sixty species of *Ostrea* distributed all over the world. The greater part of them are diœcious, while the recorded species of the monœcious oyster are not many The first four species given below have already been recorded as having every character of a monœcious species.

I here introduce one more species of the monœcious category which has not yet been recorded as such, namely, *O plicata* Chemnitz, or *O plicatula* Gmelin, the latter being probably the synonym of the former. There are therefore five species now known to be monœcious *Ostrea*, as follow

O densełamellosa Lischke, the Japanese species
O edulis Linn, the European species.
O lurida Carpenter, the British Columbian species.
O. angasi Sowerby, the Australian species.
O. plicata Chemnitz

The present species is found on the east coast of Japan It is by no means very rare, yet it has not attracted much attention of biologists or laymen, as its size is always rather small The species can attain sexual maturity in one full year, showing 'white-sick' and 'black-sick' stages, as is typical for the monœcious habit The size at maturity is only three centimetres in the longest diameter Even the largest specimen rarely attains more than six centimetres.

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Television Inventions.

IN NATURE of April 27, p. 637, a notice appeared of a book by Mr. C Francis Jenkins, of Dayton, Ohio, entitled "Radiomovies, Radiovision, Television". With some difficulty I have obtained a copy of this book from America, and find in it, in a picture which appears to be on page 74 (though no paging is given), a description copied from a journal of July 25, 1894, ascribing to C. Francis Jenkins an apparatus for transmitting pictures by electricity, under the name of the Jenkins' Phantoscope. This is identical in all essentials with the method of television proposed by G R. Carey, an American, and dated 1875 according to "La Television Electrique", by A. Dauvillier, published much later, in 1928, by *La Revue Generale de L'Electricite*, of Paris; while an illustrated description of Carey's method also appears in a copy I possess of *Design and Work* for June 25, 1880.

These discrepancies in dates are worthy of notice, as is also the suggestion in "Television", by Alfred Dinsdale (editor of the *Television* magazine), published so recently as 1928, that Baird's transmitter was the first means by which real television was achieved, a means illustrated by apparatus at present on view in the Science Museum, South Kensington, in which the picture was formed piece by piece by passing light through staggered apertures in rapidly revolving discs, but which was, according to Dauvillier's very comprehensive survey of television inventions, actually patented by Nipkow, a German, so long ago as 1884, some forty-two years before the arrangement was attributed to Mr J. L Baird, that is to say, actually five years before Mr Baird appears, from "Who's Who", to have been born.

A. A. CAMPBELL SWINTON.

40 Chester Square,
London, S W.1,
May 28.

Down House and Darwin.

DOWN HOUSE, the home of Darwin from 1842 to 1882, now vested in the British Association in custody for the nation, was formally dedicated to the public access on June 7 A distinguished company of members of the General Committee of the British Association, representatives of Darwin's family and of societies to which he belonged, and other invited guests, listened to the short ceremony at which Sir William Bragg, president of the Association, was in the chair, and Sir Arthur Keith was the principal spokesman

It will be remembered that Sir Arthur Keith, at the conclusion of his presidential address on the present position of Darwinism, at the Leeds Meeting of the Association in 1927, put forward a plea for the preservation of Down House This was promptly answered by Mr. Buckston Browne, F R C.S , who (in brief) bought the property, gave it to the Association with a generous endowment, has fully restored the whole house, and has brought back the ground floor as nearly as possible to its condition in Darwin's time, presenting many appropriate objects of art from his own collection. Truly a noble benefaction, and one which imposes new and welcome duties upon an Association which should prove itself peculiarly fitted for discharging them The nearest parallel to them is found in the Association's action in 1842, when it saved Kew Observatory from being diverted from scientific use, and sustained the burden of its maintenance for thirty years Down House, however, will be no burden, but a very honourable trust.

FIG. 1 —Darwin's house at Down, Kent

Those whose minds find no appeal in the sentiment underlying the establishment of this memorial to one of the greatest of all leaders of research cannot be otherwise than an insignificant minority. To the many it will mean more than a little to recapture, as they still may, the atmosphere in which Darwin, in the words of the inscription now erected beside his entrance gate, " thought and worked for forty years ". They may view the ' old study ' in which the ' Origin of Species " was written, and others of his rooms, restored with much of his own furniture and articles of use, which have been sent back to their place by members of his family and other generous donors They may pass through his gardens (in the restoration of which the Association has no small task before it) , they may follow him around the Sand Walk and still enjoy, as he did, the view across the pleasant valley towards the Sow Wood, as yet untouched by the builder or any other modernising influence save the gentle intrusion of a golf course , and here is indicated a further justification for the preservation of the property. A pamphlet issued by the Association for distribution to visitors quotes a description of the neighbourhood as " intensely rural and quiet though only sixteen miles from London Bridge ", and points out that Down still preserves these characteristics. " It may well be that in the future, as the outer circle of London extends, the preservation " of the estate " will be regarded as an æsthetic blessing only less than as a dutiful tribute " to Darwin's memory.

Behind these considerations, however — one fundamental, the other at least powerful—there arises the hope that the estate may be put to use for the direct benefit of science. The attainment of such an object is present in the minds of the donor, of the members of the Down House Committee which the Association has appointed for the management of the property, and of others besides No plan has as yet taken definite shape , none could or should be given effect in a moment. But it is not difficult to envisage more than one direction in which this idea—rather, this ideal—could be realised Meanwhile, when it is realised that the property was only vacated by the previous tenant six months ago, the condition of the property remarkably attests Mr Buckston Browne's generosity and enthusiasm A most distinguished American biologist has characterised his action as " initiating one of the most splendid movements of all time ". An American committee has been appointed to co-operate with the Association's committee, especially in endeavouring to recover Darwiniana now in America There are those who look forward to Down as a scientific Stratford-on-Avon for future generations. So may it be

The British Eclipse Expeditions of May 9, 1929.

By Prof. F. J. M. Stratton

BY the time these notes appear in print, the facts on May 9 will be known of the eleven expeditions from France, Germany, Great Britain, Holland, Japan, and the United States which are at present scattered on the line Sumatra—Kedah—Siam—Cambodia—the Philippines. News can only be supplied here of the Japanese expedition under Prof. Sotome to Titra in Kedah, of the German expedition under Dr. Rosenberg to Khoke Bhodi in Siam, and of the two British expeditions to Alor Star in Kedah and to Pattani in Siam. In all cases it can be said that preparations are well in hand, attended so far by no serious delays or troublesome mischances.

FIG. 1.—British observers' camp at Pattani.

Shelters of atap palm, in many cases supplemented by canvas or other linings to get the effect of a double roof, cover the instruments; preliminary adjustments are made and weather conditions do not seem likely unduly to hinder the final adjustments. So far as can be gathered by comparison with present weather conditions, prospects are most favourable at Pattani: their Majesties the King and Queen of Siam are to visit the British camp there for the eclipse, as in 1875 the then King of Siam observed the eclipse from Sir Arthur Schuster's camp.

In Kedah the Resident Adviser to the Regent has done everything to facilitate the work of the expeditions. Dr. and Mrs. Jackson are staying at the Residency and the eclipse camp is close by. The necessary electric current required for Dr. Carroll's comparison arc spectra, and for the mercury lamp to be used by Dr. Aston for the interferometer, has been obtained from the town mains, and through the kindness of the Regent all constructional work required has been done by the P.W.D. Photographic troubles have been largely met by the kind permission of the medical authorities to make use of the dark-room facilities at the local hospital.

In Siam the conditions are much more difficult, but the Siamese authorities have done everything possible to facilitate the work of the observers. At each place the Government has erected a hut camp with mess-room, office, kitchen, six rooms and servants' quarters, lit by electric light. All constructional material required and labour have been supplied, arrangements made to guard the eclipse camps and to meet the requirements of the observers in the matter of electric current by the provision of portable electric plants. His Majesty the King of Siam appointed a special reception committee charged with the duty of helping the astronomers in every way, and right well have they carried out their allotted task. All the local authorities in their turn have added to the obligations that the expeditions are under to the Siamese people. Photographic difficulties are not

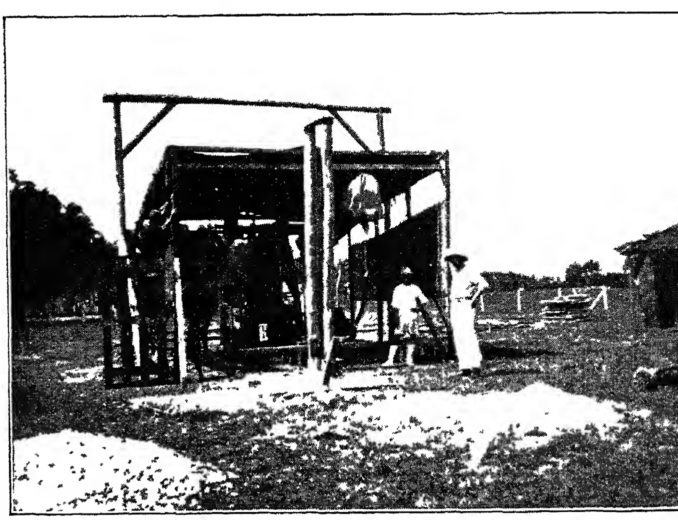

FIG. 2.—Telescope in position at Pattani.

insuperable, though real, in this hot climate A good deal can be done to meet them with ice from the local factory, and an efficient cooling plant, specially designed to meet the requirements of an eclipse dark room, should make matters still easier by providing a good supply of cooled water

Most of the personnel for the actual observations have already arrived, but special mention must be made here of the services to the British expeditions of their honorary secretary, Col J Waley Cohen. Not only did he thoroughly explore both sides of the peninsula in 1928, bringing back valuable information as to meteorological conditions and as to local possibilities for eclipse preparations—and incidentally he interested many influential people in the coming eclipse—but he also arrived in the East this year ahead of the observers and made all the preparatory arrangements, so that a great deal was already done and in hand when they arrived. At Pattani, Col Waley Cohen has also continued to relieve the scientists of the expedition of all worries about such matters as messing, local financial arrangements (not easy when there is no bank within many hours' journey of the camp), and the multitudinous details which have to be attended to, if matters are to go smoothly

The accompanying photographs, taken by Dr. Royds, director of the Kodaikanal Observatory, show (Fig 1) the special camp erected for the observers to live in, and (Fig 2) the astrographic telescope from Greenwich in course of erection with Mr P J Melotte's instruments, including a coronagraph of 19 ft focal length with a direct vision prism for the first and second flash, three spectrographs, and a double tube camera with a Nicol prism in front of one object glass for a polariscopic study of the corona The party of the observers and assistants on the day of the eclipse will be twelve In addition to those above mentioned and myself, Prof E Barnes and W. F Kibble, of Madras, have already been at the camp for some days and given valuable help

Einstein's and other Unitary Field Theories: An Explanation for the General Reader.

By Prof. H. T H. PIAGGIO

II

GEOMETRY ON A SPHERE

THE leading ideas of the geometry that Einstein chose (Riemannian) can be made clear by considering the properties of a geographical globe (Fig. 1) on which are marked the meridians and parallels of latitude These divide the surface into what we may call curvilinear rectangles But these rectangles are not all of the same size or shape For consider two points with the same latitude but with longitudes differing by one degree. The distance between them depends upon the latitude, it is greatest at the equator and zero at the poles Thus APB is greater than DQC For a sphere the distance between two points with the same longitude (*i e* on the same meridian), but with latitudes differing by one degree, is constant, but if our globe (like the earth itself) is flattened at the poles, this distance will again depend upon the latitude

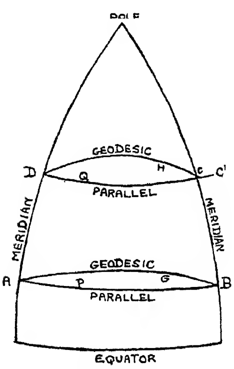

FIG 1.

In either case, we cannot find the distance between two points A and C on the globe merely by knowing the *differences* of their latitudes and their longitudes, whereas in a plane the distance between two points is determined solely by a knowledge of the differences of their x and of their y co-ordinates This is what is meant by the rather alarming statement that the sphere has a Riemannian metric, while the plane has a Euclidean one (In mathematical symbols, $ds^2 = dx^2 + dy^2$ shows a Euclidean metric, but $ds^2 = g_{11}dx^2 + g_{22}dy^2$ shows a Riemannian metric, provided that g_{11} and g_{22} are functions of x and y, or of either of them.)

It is not only a plane that has a Euclidean metric. Take a piece of squared paper, and roll it up, or bend it (without stretching or tearing) into as queer a shape as you please. The squares drawn on it remain all of the same size as before, hence the metric is still Euclidean. Such a surface is said to have zero *Gaussian curvature*, although it is what an ordinary person would call curved. The real distinction between it and a sphere is that the squared paper can be flattened out again, whereas it is impossible to flatten out a sphere or a piece of it (as may be easily verified with a piece of a broken rubber ball) Another way of putting this is to say that any attempt to make a flat map of the earth must be imperfect and give a distorted representation, as is obvious on Mercator's chart near the poles

A well-known problem in geography or navigation is to determine the shortest route that can be traversed between two points on the earth's surface. On a model globe we can determine this experimentally by stretching a piece of string between these two points. It will be found that it will lie in what is called a *Great Circle*, namely, one the plane of which passes through the centre of the earth It is important to notice that it is not the same as a parallel of latitude In fact a ship that has to sail between two points A and B on the same parallel APB (north of the equator) will, to follow the Great Circle AGB, have to sail north of this parallel and then come back to it, a method rather tiresome to navigators, as it entails a continual change of direction (as measured by compass bearing). A Great Circle on a sphere has one of the properties of a straight line in a plane, namely, that of being a *geodesic* or shortest distance between

two points on it, but not (in general) another, that of having a constant direction This may be considered to belong to a route that makes a constant angle with the meridians, it is called by navigators a *rhumb-line* or *loxodrome*. They often use it, in spite of it not being a geodesic, because it preserves a constant compass bearing, which can be determined at once by drawing a straight line between the two positions, as marked on Mercator's chart. It is important to notice that what we here call constant direction on a sphere is defined by reference to compass bearing, or Pole star, or axis of rotation (through which the meridians pass), each of which is really quite independent of the geometry of the sphere itself, and to that extent is arbitrary

GEOMETRICAL BASIS OF EINSTEIN'S GENERAL THEORY

Einstein's General Theory may now be stated broadly as the assumption that the physical geometry of space-time is one which has a Riemannian metric and a curvature, and, in fact, is somewhat analogous to geometry on a sphere The analogy is made closer if we replace the sphere by a surface like a hen's egg, of which the curvature is variable If the egg has been hard-boiled and then deprived of its shell, so as to be flexible, the analogy is still further improved, for the Gaussian curvature and Riemannian metric, which depend only on a network of curves drawn on the surface and deformable with it, are the properties with which Einstein is concerned It is important to notice that no account is taken of any measurements except those made *on* the surface, which from this point of view is a two-dimensional region.

The non-mathematical reader may, however, say, "How can two-dimensional results on a sphere or egg, which everyone can imagine, be applicable to four dimensions, which are inconceivable?" The answer to this is that the symbols used by mathematicians have the valuable property that they enable us to work, largely by analogy, in four dimensions almost as easily as in two The merit of Riemannian geometry, which to those unfamiliar with it may appear rather complicated, is that in it the physical laws of the motion of a planet or of a ray of light are the simplest possible, namely, that they are geodesics By stipulating that the paths must be very nearly those given by Newton's law of gravitation, we get some indication of how to determine the coefficients in the Riemannian metric To determine these fully requires other considerations too lengthy to enter into here

As is now well known, this theory has been strikingly successful, not only in explaining a known fact, the anomalous motion of the perihelion of the planet Mercury, but also in predicting successfully the effect of a strong gravitational field on the bending of light and the shift of spectral lines. Eclipse expeditions speedily confirmed the first prediction, but the second was originally denied by experimenters The spectral shift is now admitted to exist, and the minute effects due to the sun have been supplemented by the more easily observed effects due to the dark star of enormous density called the Companion of Sirius.

PHYSICAL BASIS OF THE UNITARY FIELD THEORIES OF WEYL, EDDINGTON, AND EINSTEIN

We have seen that the Special Relativity theory is fundamentally an electromagnetic one, while the General Theory is fundamentally gravitational After constructing a geometry of space-time, specially chosen so as to explain gravitation in a simple manner, Einstein found that electromagnetism could be fitted into the scheme, but could just as well be left out Now this is scarcely satisfactory Gravitation and electromagnetism are both physical phenomena, and why should one be considered as an essential property of space, and the other as only an accident? Was the world constructed solely for the requirements of gravitation, and then part of it let off to electromagnetism as a lodger? The obvious thing seemed to be to modify the Riemannian geometry so that it would serve gravitation and electromagnetism equally well

GEOMETRICAL BASIS OF WEYL'S UNITARY THEORY (1918).

Einstein had made gravitation appear as a natural consequence of replacing Euclidean geometry by Riemannian, in which the geodesics lose their property of preserving a fixed direction. Weyl proposed to replace Riemannian geometry by another, in which the idea of length is also given up In his theory, at any rate in its original form, the length of a rod altered every time it passed round an electric current! This theory certainly gave some interesting mathematics, in which equations of the form of Maxwell's electromagnetic ones made their appearance, but as it has received no experimental confirmation whatever, it need not be considered very seriously

EDDINGTON'S UNITARY THEORY (1921) AS A 'GRAPH'.

Weyl's geometry, formless as it seemed, still retained one definite property, of which Eddington promptly proceeded to divest it We shall not enter into details, because Eddington avowedly is not claiming to construct a physical theory, but only an illustration or 'graph', which may be looked upon as a device useful in enabling us to grasp certain mathematical relations He hoped it might throw light on the nature of the forces which prevent an electron from exploding, but up to the present it does not seem to have done so

Eddington considers that not only his own unitary theory, but also Weyl's and Einstein's, are 'graphs' However, from Einstein's own words—"my opinion is that our space-time continuum has a structure of the kind here outlined"—it would appear that it is claimed to be a genuine physical theory

EINSTEIN'S UNITARY THEORY (1928–29).

Whereas Weyl and Eddington replaced Riemannian geometry by others still more unlike Euclidean, Einstein has now, in part, returned to more ordinary ideas. His geometry is one which possesses *distant-parallelism* as well as a Riemannian metric. To explain what is meant by distant-parallelism, we return to our two-dimensional analogy. Cover our hen's egg, or any other surface, with a network of 'curvilinear rectangles'. 'Parallel directions' are defined as those which make the same angles with corresponding sides of the local rectangles. This definition leaves the original choice of the network undefined, but we saw that on a sphere direction had to be defined by something, like a magnetic compass or a pole star, which was not a property of the sphere itself, and so in a certain sense undefined by its geometry alone.

Perhaps Einstein's parallel directions may be ultimately defined in terms of dynamics. He may even get back to the position of Newton, who conceived absolute rotation to be a real thing, which could be detected by seeing whether the surface of a fluid was a paraboloid of revolution or a plane. The behaviour of Foucault's pendulum and of gyroscopes certainly seem to furnish us with a dynamical definition of direction.

By using our sphere, we may even give some idea of the actual function that Einstein takes to measure what may be called electromagnetic potential. Suppose a boat has two short trips, each of one mile, one east and the other north. By sailing first one mile east and then one mile north, let us reach a point C. By sailing first north and then east we reach a different point C′, since the parallels of latitude get smaller as we go north (see Fig. 1). The distance CC′ represents Einstein's potential. This illustration is not exact, because on a sphere CC′ is very small compared with the distances AB, BC, whereas in Einstein's theory it is essential that it should not be so. To illustrate this we should have to suppose our sphere to have a crinkly surface.

If we now take the corresponding construction for three dimensions, the result is rather queer. If AB and DC are 'parallel' paths, the path from B 'parallel' to AD will not intersect DC. It is properties of this kind that Eddington finds unattractive, but they are essential to the electromagnetic part of the theory.

Of course the ultimate test of the theory must be by experiment. It may succeed in predicting some interaction between gravitation and electromagnetism which can be confirmed by observation. On the other hand, it may be only a 'graph' and so outside the ken of the ordinary physicist. Einstein's paper points out that so far there has not been time to examine the full consequence of his equations.

Even supposing the theory fully established, there are still fresh worlds for Einstein to conquer. The quantum theory remains outside his scheme. He made an attempt to deal with this so far back as 1923, but without any striking success. However, it has been suggested that the postulate of distant-parallelism will enable the unitary theory to take over Dirac's theory of a spinning electron almost unchanged.

The Detection of Helium.

THE natural facility with which the radioactive elements disintegrate has led on one hand to attempts to break down atoms artificially, and on the other to build them up from simpler particles. Rutherford succeeded in conveying the necessary energy to some of the less massive atoms and broke them down by bombardment with sufficiently energetic α-rays, atom by atom at comparatively rare intervals: the process of atom building is still not more than a dream, realised perhaps in the depths of space as Millikan has suggested in order to account for cosmic rays.

The production of gold from mercury, and many another attempted transmutation, have proved, to put it mildly, apparent rather than real changes. In the case of the experiments in which helium was supposedly formed in some way or another by an electric discharge, there has lurked for a long while a certain feeling of unsatisfactoriness. Prof. Paneth's recent work goes far to dispel this feeling (see *Zeits. f. phys. Chem.*, **134**, 353; 1928, and **1**, 170 and 253, 1928). The outcome is indeed satisfactory: those that found helium have reason to have got it, those that did not might well have found it, and been misled perhaps as to its origin.

Paneth and Peters show that helium is the only gas which at ordinary temperatures can diffuse through glass. At a pressure of 0·5 atmosphere 10^{-11} c.c. of helium will pass through a thickness of 0·5 mm. of soda glass per cm.^{2} per hour. The amount of helium that gets through from the air at ordinary pressure into an evacuated glass vessel (1 mm. wall thickness) is 10^5 times less, so that a glass apparatus is for all practical purposes 'tight' at ordinary temperatures. When warm the rate of diffusion through the glass is much greater (cf. Lo Surdo, *Atti R. Accad. Lincei*, **30**, 1, 85, 1921). A hard glass tube 1.5 mm. thick at 500° C. lets through 10^{-9} c.c. of helium from the air per cm.^{2} per hour. Helium, indeed, can be separated from neon and other gases by diffusion through hot glass. It is otherwise with palladium. Helium will not diffuse through palladium at a red heat. A mixture of helium and hydrogen can be separated completely by diffusion of the hydrogen through a palladium capillary; the quantity of helium that gets through is not even 10^{-12} of the quantity of hydrogen that passes. Helium and neon are found in the gases absorbed by glass which has been in contact with air, but the gas is considerably richer in helium than in neon. On the other hand, if there is a minute flaw in the glass or at a tap, causing a leak however small, the neon and helium found in the residual gases remain in the same proportion as

they exist in the air, approximately 3 : 1. (It is noteworthy that Paneth and Peters found that good taps could be relied on not to leak if properly ground and greased; their apparatus was therefore not made tap-free. Twenty taps standing 48 hours had not leaked to the extent of more than 10^{-6} c.c. air, equivalent to about 10^{-10} c.c. Ne and He.) It can be shown that a vacuum tube which becomes heated by a discharge will contain afterwards traces of helium, if it is not protected from access of air externally, however great other precautions may have been taken to prevent ingress of air. A double wall is not even sufficient if both become warm. It is necessary to immerse the tube in water or in oil which cools and at the same time seals the glass. The presence or absence of helium in the residual gases is therefore mainly a question of the temperature of the walls of the tube and the sensitiveness of the method of detection.

Paneth gives 10^{-12} to 10^{-11} c.c. as the limiting volume of helium which can be detected spectroscopically. This means that in his apparatus the helium and the neon in about 10^{-5} c.c. of air can be detected—a limit about 100 times smaller than that given for the method used by Strutt (*Proc. Roy. Soc.*, A, **89**, 499; 1914). A careful study is made of the quantity of gas required to bring out the various spectral lines for the pure gases neon and helium and their 3 : 1 mixture obtained from atmospheric air. The spectra of the gases are examined using a capillary tube about 0.1 mm. bore; the fine capillary makes it unnecessary to use a slit with the spectroscope. Excitation is provided by external electrodes. The results enabled estimation of very minute quantities of the gases to be made without recourse to uncertain volume measurements in fine capillary tubes. For quantities at the limit of detection (10^{-10} c.c.) only the 5875 and 5015 lines of helium are visible and only the 5852 line of neon. The latter masks the 5875 helium lines in a mixture of the two gases and only 5015 remains visible. Paneth succeeded in this way in measuring the quantities of helium (about 10^{-8} c.c.) generated by only about 40 grams of thorium in 113 days, taking very special precautions to prevent contamination with helium from other sources. Even with every precaution a trace of neon was also detectable.

Either calcium or an electrically heated spiral of palladium were employed for removing large quantities of hydrogen from the gases under examination; for smaller quantities combustion with oxygen at the surface of palladium sponge was used. The gases were taken from place to place along with oxygen which was afterwards removed by absorption with cooled charcoal, the residual rare gases being 'run up' into the capillary tube for the spectroscopic test. Special precautions were taken to prevent any rare gases being present in the electrolytically generated hydrogen and oxygen used throughout the work; these latter were shown to contain less than about a millionth of a per cent of air. All parts of the apparatus with large glass surfaces and those subjected to heat were vacuum jacketted and then immersed in water.

Paneth and Peters have bombarded salts of potassium; they have run a heavy discharge through hydrogen between aluminium electrodes at pressures from 1 to 85 mm. and also between a palladium spiral electrode through which a large quantity of hydrogen was diffused, without obtaining any helium or neon other than traces from ascertained sources. They have tried a powerful silent discharge through hydrogen at 10 to 760 mm. pressure and they have passed a heavy discharge through paraffin, examining the hydrogen so generated. In all cases the results were negative, provided the glass was protected from transfusion by helium from the air. In spite of the stability of helium and the possibility of building it up from protons and electrons with evolution of 7×10^{11} cals per mol, these experiments show that even with a favourable high concentration of hydrogen, the amount of helium so formed is certainly less than 10^{-9} c.c. The same result applies to the production of helium by bombardment of water and of mercury with β and γ rays. To these experiences have to be added those of Allison and Harkins (*J.A.C.S.*, **46**, 814; 1924) in which very heavy discharges were employed, yet with no positive effects. Considering, too, that the sensitiveness of detection in Paneth and Peters' work is claimed to be 10^4 times greater than the volumes of helium and neon obtained in those experiments by other workers which have appeared to give positive results (*e.g.* production of helium from salts of potassium where the quantity found was between 10^{-5} and 10^{-6} c.c.), it is fairly definite that their source must be other than permitted by Paneth's arrangements and precautions.

One of these sources, when helium is alone found, is no doubt the diffusion of helium through heated glass (or quartz). It is interesting to note that this was also the conclusion of Masson in his experiments with the quartz mercury arc (*Proc. Roy. Soc.*, **91**, 30; 1915). It is noteworthy that Paneth found that glass which is exposed to air contains helium and less neon (50 cm.^{2} of glass holds more than 10^{-6} c.c. He). Hydrogen greatly assists the removal of these adsorbed gases. Oxygen, however, has practically no effect in 'washing' them out of the glass. Heating alone without washing with hydrogen is also comparatively ineffective. This fact seems also to explain some features of the earlier work. Prof. Paneth's work has gone a long way to clear up the unsatisfactory state in which this subject had been left. There is now no evidence for the formation of the rare gases by the discharge, but very definite reasons for their detection in the kind of experiments which were carried out (*e.g.* presence of He in X-ray tubes as found by Ramsay (NATURE, **89**, 502; 1912)).

Passing from experimental work of a critical nature to that with a more constructive object, Paneth has utilised his methods of detection of minute quantities of helium in connexion with a variety of other problems (see *Zeit. anorg. Chem.*, **175**, 383; 1928; and *Zeit. f. Elektrochem.*, **34**, 645; 1928). Amongst them may be mentioned the origin of the abnormal helium content of sylvin and beryl,

the quantity and origin of helium in gases of natural origin, and the helium content and age of meteorites. At Ahlen, in Westphalia, a source of natural gas has been found to provide about 40 m³ per day containing 0 19 per cent helium, but this does not compare with the source at Calgary in Canada, 330,000 m³ per day containing 0 33 per cent He, or with that at Petiola in Texas, 425,000 m³ per day of 0·9 per cent The ages of the various iron meteorites investigated are found to range from that of the Savic meteorite (8000 years perhaps) to the hoariness of the Nelson Co meteorite, comparable to the age of the earth ($2 6 \times 10^9$ years) It is thought that passage near the sun might account for the removal of helium from the Savik meteorite, making it appear more youthful than it is really likely to be.

Another interesting direction of Prof. Paneth's work was in the attempt to prepare helides after the manner in which he has so successfully made hydrides of various elements No trace of the formation of helides of arsenic, antimony, lead, germanium, selenium, iodine, and chlorine was obtained In the experiment with chlorine, the merest trace of the formation of a helide would have been detectable It is considered that such helides as can be formed can only have a very fugitive existence, of the order of 10^{-8} second

One might recall the words of Leonardo da Vinci in connexion with all this illuminating work: "Experience is never at fault, it is only our judgement that is in error in promising itself such results from experience as are not caused by our experiments" A C E

Obituary.

GEORGE BIRTWISTLE

GEORGE BIRTWISTLE was born at Burnley in 1877 Educated at Burnley Grammar School and Owens College, he won an open scholarship in mathematics at Pembroke College, Cambridge, in 1895 He was bracketted Senior Wrangler in 1899 and was placed in Class I, Division I, of the post-graduate part of the Mathematical Tripos in the following year. He was immediately elected to a fellowship and was responsible for the mathematical teaching in Pembroke until the time of his death He had also served as assistant tutor and prætector of the college He died very suddenly and unexpectedly on May 19

It was as a teacher rather than as an investigator that Birtwistle was known, and as a teacher that he played a conspicuous part in Cambridge mathematics, especially during the last ten years. In certain respects his position was unique, for he was a link between the older theoretical physics and the new Since the War, while continuing to lecture on classical mechanics, electrodynamics, and hydrodynamics, his interest in more recent developments, always strong, rapidly increased. He began to lecture on the older quantum theory, on thermodynamics (then just introduced into the schedule of elementary teaching), and finally on modern quantum mechanics Each of these lecture courses ultimately grew into a book

As a lecturer, Birtwistle was admirably clear and easy to follow He set, in fact, a standard of exposition which made it very difficult for anyone to attract students to any duplicate course. His books are like his lectures—admirable expositions of those sections of the subject with which he deals, written in lecture-room style He seldom attempts to go deeply into difficult points or to present the subject as a single logical whole His aim is the lecturer's aim—to interest the student in the subject, especially in its more outstanding or exciting parts, and lead him on to other more systematic or abstruse expositions

In all his lectures and in all three books, Birtwistle was successful in this aim, though naturally in varying degrees Perhaps the least successful of his books was the last, on modern quantum mechanics. Here, owing to the novelty of the subject and the absence (when Birtwistle wrote) of other more systematic expositions (or indeed of any other exposition), the weakness of his deliberate method becomes more obvious The book gives rather the impression of a collection of interesting isolated sketches. It stimulates the reader to ask for more, but to what other author is he to turn? With the coming of other books the weakness is already less felt and Birtwistle's book is gaining in value as a stimulating introduction. The staff of the Mathematical Faculty of Cambridge mourn the untimely loss of a valued friend and colleague.

DR. W. MARTIN.

DR WILLIAM MARTIN, who died on May 24, was known to a very wide circle as an antiquary whose knowledge and insight enabled him to see almost everywhere in London vestiges of the life and activities of former times; but to many others he was known as an authoritative exponent of patent law, and he was an occasional contributor to our columns upon this subject.

Dr. Martin's antiquarian bent led him to treat patent law historically; but he was none the less alive to the conceptions which govern modern practice in this sphere. In his lectures and publications, notably his articles in the *Law Quarterly Review*, he worked out with great originality a systematic key to the immense body of decided cases with which he seemed to be familiar in every part. The law of treasure trove also attracted him, and in it he saw, contrary to the opinions of some antiquaries, means which could be utilised for the advantage of archæology as a check on the surreptitious disappearance into private collections of finds of general interest.

As an antiquary Dr. Martin was insistent on a strict separation of ascertained fact from the accretions of sentiment and fancy which too often obscure instead of illuminating the past Nowhere was he more impatient of any looseness than in his

treatment of Shaksperiana He was an acknowledged authority on Shakspeare, and was proud of the part he took as president of the Shakspeare Reading Society in placing in Park Street, near Bankside, the handsome bronze memorial which now marks the site of the 'Globe'.

Dr Martin was a graceful writer, clear and entertaining as a lecturer, and an ideal guide; with a very practical gift for organising which enabled him to carry through his arrangements strictly to time Perhaps he found his greatest happiness in conducting parties through almost forgotten alleys and byeways of London which he loved, and filling them from his stores of knowledge with pictures of the life of other days. Many are those who have enjoyed afternoons spent with him on these rambles who will still find pleasure in the remembrance of his easy discourse and the charm of his personality He was keenly interested in many aspects of natural history, as well as being an authority upon archæological subjects, and he served as president of the South-Eastern Union of Scientific Societies. It was particularly appropriate that Dr Martin should be elected the first president of the Gilbert White Fellowship, the object of which is "To continue the work of Gilbert White in the study of natural history and antiquities". He took an active part in the meetings and excursions of this Fellowship within a few days of the illness which resulted in his regretted death.

WE regret to announce the following deaths:

Prof. Thomas W. Cave, vice-principal of the South-Eastern Agricultural College, Wye, and for twenty-seven years head of the Veterinary Department of the College, on April 25, aged seventy years.

Mr. A. H. Cheatle, C B.E, the distinguished aural surgeon, who presented to the Royal College of Surgeons his valuable collection of preparations illustrating the anatomy of the mastoid region, on May 11, aged sixty-two years

Prof Peter Gillespie, professor of civil engineering, University of Toronto, at fifty-six years of age

Commendatore Rodolfo Lanciani, K C V O, Senator of the Kingdom of Italy and formerly professor of Roman topography in the University of Rome, on May 21, aged eighty-three years

Dr. James Moir, a past president of the Chemical, Metallurgical and Mining Society of South Africa and of the Chemical Section of the South African Association for the Advancement of Science, on Mar 31.

Mr. O. A. Reade, pharmaceutical chemist, president of the Lowestoft and District Literary and Scientific Association, and author of a flora of the Bermudas, on April 14.

News and Views.

THE King's Birthday honours list includes the names of the following scientific workers and others associated with scientific activities *Baron*. Sir Edward Allen Brotherton, chemical manufacturer. *Privy Councillor*. Lord Dawson of Penn, Physician-in-Ordinary to the King *Baronets*. Sir E. F. Buzzard, Physician Extraordinary to the King; Sir Hugh Mallinson Rigby, Sergeant Surgeon to the King. *Knights* Prof. H. C. H Carpenter, professor of metallurgy in the Royal School of Mines, Imperial College of Science and Technology; Mr J J Ralph Jackson, Chief Veterinary Officer, Ministry of Agriculture and Fisheries; Mr. W. S Jarratt, Comptroller-General of the Patent Office; Prof. W C MacKenzie, Director, and professor of comparative anatomy, National Museum of Australian Zoology; Dr. Peter Chalmers Mitchell, Secretary of the Zoological Society of London, Prof. C. V. Raman. Palit professor of physics in the University of Calcutta, Brigadier E. A Tandy, Surveyor-General of India (retired); Dr. R. S. Woods, Honorary Physician and Honorary Surgeon, London Hospital *K C.B.*. Sir F S. Hewett, Surgeon Apothecary to the King. *C.B.:* Major-General H P. W. Barrow, Director of Hygiene, War Office. *C.S.I.*· Mr. James Herman Field, late Director-General of Observatories, India. *G.C M.G.:* Sir John Cadman, emeritus professor of mining, University of Birmingham *C M.G :* Dr. L Cockayne, in respect of honorary scientific services to the Government of the Dominion of New Zealand; Mr. O. F. H. Atkey, Director of the Sudan Medical Service. *G.C.V.O.:* Sir Humphry Rolleston, Physician-in-Ordinary to the King. *C.V.O.:* Dr. L E. H Whitby, bacteriologist *M V O* Prof. E C Dodds, professor of bio-chemistry at Middlesex Hospital *C.I S O* Mr W A Baker, lately Surveyor-General, Jamaica; Mr J. F Halpin, Superintending Chemist, Government Chemist's Department. *G.B E.:* Prof. Dame Helen Gwynne-Vaughan, professor of botany in the University of London; Sir Arthur McDougall Duckham, Director-General of Aircraft Production. *K B E*· Major-General T. H Symons, Honorary Surgeon to the King, Director-General, Indian Medical Service. *C B E*· Mr. P. N. H Jones, Director of Public Works, Bermuda, Lieut-Col F J McCall, Director of Veterinary Services, Tanganyika Territory; Capt R. S Rattray, for services as Government Anthropologist in the Gold Coast and to aviation in West Africa, Col A. H Safford, Assistant Director of Medical Services, Baluchistan District, India, Mr Nicholas White, Chief Engineer, and Secretary to the Government of the Punjab, Irrigation Branch *O B.E*· Mr. H. Brown, Principal Officer, Plant and Animal Products Department, Imperial Institute, Major D. G. Cheyne, Deputy Assistant Director of Hygiene, China Command, Dr. F Dixey, Director of the Geological Survey, Nyasaland Protectorate, Major J. N. Duggan, professor of ophthalmic medicine and surgery, Grant Medical College, Bombay, Mr. J. C. F Fryer, Director, Ministry of Agriculture and Fisheries Pathological Laboratory, Harpenden; Lieut.-Col F. J M Stratton, professor of astrophysics in the University of Cambridge, Mr. G. Stuart, Assistant Director, Laboratories, Department of Health, Palestine. *M B.E*· Mr. E. W. Davy, Assistant Director of Agriculture, Nyasaland Protectorate.

THE Lords Commissioners of H M Treasury have appointed a committee to inquire into matters affecting the functions and staff of certain Research and Experimental Establishments of Government Departments, with the following terms of reference To examine the functions and organisation of the undermentioned Establishments in the Government Service and to report on the method of recruitment and conditions of service of the civilian scientific and technical officers employed therein: (*a*) The Research and Experimental Establishments under the Admiralty, War Office, Air Ministry, and Department of Scientific and Industrial Research, (*b*) the Department of the Government Chemist and the Establishments under the Admiralty and War Office concerned with chemical analyses, and (*c*) the Meteorological Office

THE chairman of the committee is Prof H C H Carpenter, professor of metallurgy, Royal School of Mines, and the members are Sir W. J Larke, the director of the National Federation of Iron and Steel Manufacturers, Sir Robert Robertson, government chemist, Mr. F. M Morris, the assistant secretary at the Treasury in charge of staff questions affecting the Defence Departments, Mr R J. G C Paterson, one of the directors of finance at the War Office, Dr. F. E. Smith, director of scientific research, Admiralty, Mr H T. Tizard, secretary of the Department of Scientific and Industrial Research, and Mr. H. E Wimperis, director of scientific research, Air Ministry. The secretary is Mr. H. Brittain, a principal at the Treasury

As was indicated in our leading article of May 11, the impending appointment of an inquiry into the organisation and lay-out of the research and experimental branches of the Civil Service was used in April last by the representatives of the Government on the National Whitley Council for the Civil Service as a reason for refusing a Joint Committee which the Staff Side, at the instance of the Institution of Professional Civil Servants, had proposed. It was understood that the official committee then foreshadowed would cover the whole of the research and experimental activities of government departments and would deal mainly, if not exclusively, with the widest questions of structure and organisation Under the terms of reference now announced, however, the committee's sphere of action does not include the Museums, the Observatories, or the Research Services of the Ministry of Agriculture and Fisheries, and its authority to deal with matters of high policy is apparently confined to examination. We are also a little mystified by the relationship of this new committee to the Research Co-ordination Sub-Committee of the Committee of Civil Research which was appointed in 1926 under the chairmanship of Mr. W. G. A Ormsby-Gore, and which presumably is continuing to function, since the report which it issued last year was purely descriptive in character. We understand that the Institution of Professional Civil Servants, which represents the staffs to be considered by the committee of inquiry, has been invited to submit evidence, but has not yet decided its policy.

EDUARD SUESS, the most illustrious member of the great school of geology in Vienna, was born in London on Aug 30, 1831, and the Geological Society has placed a memorial tablet on the house, 4 Duncan Terrace, Islington The tablet was unveiled on May 28, by his Excellency the Austrian Minister, Baron G Frankenstein. The president of the Geological Society, Prof J. W Gregory, remarked that Suess came of a family that was settled in South Saxony by 1524 His father was destined for the Church, in which many of his ancestors had served; but he entered the wool business, and lived for a time in London He removed to Vienna, where Eduard Suess graduated at the University, served on the staff of the Royal Museum, and was appointed professor at the University in 1857. Suess applied his geological knowledge to the provision of a better water supply for Vienna, and thereby effected a great improvement in the health of the city, which became a pioneer in the improvement of municipal water supplies Suess's world-wide scientific reputation depends on his contributions to geology and physical geography His views were most fully published in his "Face of the Earth"; they were so original and unorthodox that he was for a while regarded as a visionary, and his writings set aside as 'geo-poesy'.

SUESS's main principles have been generally accepted and have had a fundamental influence on modern ideas of the internal structure of the earth and its geographical evolution. Before his work it was generally believed that changes in the distribution of the sea and land were due to irregular local oscillations of the crust. Suess held that they were mainly regular and world-wide in range, and due to changes in the form of the earth that cause a general advance of the sea at one time and retreat at another The origin of mountain chains he attributed to the crust being folded by pressure in one direction forming waves which advance until they are stopped by older rigid masses of land, as waves of the sea are kept back by the projecting forelands along a coast. Suess ranks as the greatest original force in the geological philosophy of his time, as well as being remarkable for his influence as a far-seeing educationist and municipal reformer, statesman, and economist. The Austrian Minister expressed his pleasure at this recognition of the work of the great Viennese geologist. The Rt Hon. Sir Maurice de Bunsen, on behalf of the Royal Geographical Society, expressed appreciation of Suess's work. Dr F. A. Bather, representing the Royal Society, referred to the scientific imagination with which Suess handled his material. Alderman Harper, the Mayor of Islington, promised that the local authorities would see to the safety of this memorial to one of the illustrious sons of Islington. Sir Arthur Smith Woodward and Prof W. J. Sollas, in moving a vote of thanks to the Austrian Minister, referred to Suess's nobility of character and literary distinction.

A PARTICULARLY interesting account is given in the *Engineer* of May 31, of the replica of the famous locomotive *Rocket*, which won the competition at

Rainhill on the Liverpool and Manchester Railway in October 1829, and at the same time established once and for all the suitability of the steam locomotive for railway work. The original *Rocket*, or what remains of it, stands in the Science Museum, South Kensington, but the replica has been made for Mr. Henry Ford for his museum at Detroit The task of building the new *Rocket* was given to Messrs. Robert Stephenson & Co, Ltd, Darlington, the successors of the old Stephenson firm at Newcastle, and immense pains have been taken to follow as closely as possible the original plans. As is well known, the original *Rocket* was altered very considerably and to-day many parts are missing The design of the fire-box—one of its most important features—has long been a matter for inquiry and discussion, but apparently the experts are now fairly well agreed as to the details, and in the replica Mr Ford possesses what is undoubtedly the most complete piece of engine reconstruction ever carried out. Though there are various memorials to George and Robert Stephenson and to Henry Booth, who were jointly responsible for the building of the *Rocket*, on June 8 we shall possess another memorial to George Stephenson, for on that day the Lord Mayor of Newcastle-upon-Tyne will unveil a tablet on the cottage at Wylam, Northumberland, where he was born. The tablet has been erected through the joint efforts of the North-East Coast Institution of Engineers and Shipbuilders and the Institution of Mechanical Engineers

MR. E. B FORD, of the Department of Zoology, University of Oxford, delivered a lecture before the Eugenics Society in the rooms of the Royal Society on May 29, on "Recent Work on the Physiology of Genetics and its Bearing on Human Problems". Mr Ford stated that the physiology of genetics has only been studied in comparatively recent years. Indeed, it could scarcely have been investigated until a considerable body of evidence respecting the mechanism of inheritance had been built up. Such evidence has now been obtained, and has resulted in an accurate knowledge of the behaviour of genetic factors and of the characters for which they are responsible, but the developmental processes by which these characters are produced are still for the most part obscure. Prof. R. Goldschmidt in Germany has, however, thrown some light on this part of the problem. He was led to postulate factors controlling the *rate* of production of sex-differentiating substances in his work on sex-determination, and later in other characters, in moths. However, these are animals which differentiate by means of sudden metamorphoses. For this reason they are unsuitable for an investigation of developmental processes. This difficulty has to some extent been overcome in Great Britain by the study of a Crustacean which grows and develops throughout life. By this means it has been possible to examine in detail a number of factors affecting the rate and time of onset of processes in the body, and their interaction with each other and with the environment. It is probable that factors of this type are of great importance in the mammals. In man they should be of particular interest, since so many of the differences which separate the human species from the apes are qualitative, and depend upon rates of development and the time at which certain processes begin. We have here an indication of how such differences are inherited and controlled.

THE Zoological Society of Scotland has entered upon a new and important stage of its steady development The large area of ground, formerly a golf-course, which rises to the ridge of Corstorphine Hill, has been taken over, a road has been made traversing the new ground, large grass paddocks have been partitioned off, and a series of enclosures in the live rock has been created for beasts of prey at a cost of some £3500. Great improvements also continue to be made, we learn from the sixteenth Annual Report, in the older part of the Park. Unsightly cages have been replaced by rock-dens, and an extensive monkey-house, designed on modern lines and now in course of erection, promises to be as successful as the recently built houses for tropical birds and reptiles. The application of a device for the circulation and filtration of water has enabled the director-secretary to add a number of salt-water tanks to the Aquarium, much to its gain in attractiveness, and at a cost very much less than that of the original proposal for storage tanks During the year 86,000 visitors entered the Park, and the accounts show a record surplus on the year of more than £4700.

THE teaching of Nature study in schools has been a problem bristling with difficulties, and to these difficulties is largely due the predominant place in school-teaching taken by the more concrete sciences of chemistry and physics Part of the trouble is due to the impossibility of finding teachers with the necessary outlook and training, and this, we are inclined to think, may be traced to the tendency of the training colleges to model the biological syllabus too closely upon the botanical and zoological courses in the Universities. That is to say, too much stress has been laid upon the structure and systematics of plants and animals and too little upon life-activities. It is, therefore, with unusual pleasure that we welcome a course of Nature study, which in the hands of an intelligent and sympathetic teacher should bring to the class-room the real feeling of the progression of living things. The course is outlined week by week in *The Schoolmistress*, under the title "In England—Now!" by Mrs. Maribel Edwin, the daughter of Prof. J. Arthur Thomson. The general scheme of the series is to follow natural history the year round in Britain, and this is accomplished by striking in the first week of each month the keynote of the month, and in the succeeding weeks, by analysing the month's activities in greater detail. The treatment exhibits insight and imagination, and the wall diagram, on which pictures of the creatures and plants referred to may be hung in their appropriate environment month by month, strikes a practical note which must appeal to teacher and pupil alike.

THE fifth meeting of the Wool Breeding Council, appointed jointly by the Secretary of State for Scotland and the Minister of Agriculture and Fisheries

to advise the Departments of Agriculture for England and Wales and Scotland on questions relating to the improvement and utilisation of wool grown in Great Britain, was held at the Animal Breeding Research Department, University of Edinburgh, on May 23. Sir Robert Greig, chairman of the Council, presided. Short statements on research work in progress were submitted to the Council. In co-operation with the University College of North Wales, Bangor, large scale breeding experiments have been conducted in order to determine the mode of inheritance of the birth coat of lambs and the relationship between the type of birth coat and kemp in the subsequent fleece At the Animal Breeding Research Department, University of Edinburgh, the work includes a critical repetition of the grafting experiments carried out by Dr. Voronoff, a study of the rôle of the pituitary gland in producing early maturity, and an investigation into the possibility of securing the moulting of kemp by the use of thyroxin.

DR E N DA C ANDRADE described "The Air-Pump. Past and Present" in a discourse delivered by him at The Royal Institution on May 31. The obtaining of a vacuum is an essential step in the majority of modern physical experiments, and in many of the products of the modern electrical industry, such as the electric lamp, the thermionic valve, and the X-ray tube. With modern methods a pressure of a ten-thousand-millionth of an atmosphere can be attained, which means only a few hundred million molecules per cubic centimetre. During the past sixteen years new principles of obtaining high vacua have been applied which have proved of the utmost importance for the laboratory and electrical workshop. At very low pressure the free path between the collision which a molecule makes with others is long, and the new pumps do not come into action until this state has been reached, and so work in conjunction with a preliminary pump which reduces the pressure sufficiently In one type a cylinder provided with special grooves rotates very rapidly, and actually throws the molecules forward as sparks are thrown by a grindstone. this type of pump is usually called a molecular pump, and is very efficient, but demands great care in construction In another type, which might with equal justice be called a molecular pump, since it is based on a consideration of molecular properties, a jet of vapour entrains the molecules which diffuse into it, and the pump is therefore often called a diffusion pump. The vapour itself has to be condensed, so the pumps are also called condensation pumps Hitherto mercury vapour has generally been used for these pumps, on account of the non-volatile nature of the liquid at ordinary temperatures, but within the last year oils have been produced which can take its place, and within the last month or two another liquid still has been utilised

THE first David Ferrier lecture of the Royal Society will be delivered on June 20 by Sir Charles Sherrington, upon the subject of "Some Functional Problems attaching to Convergence"

DR. H. S. H WARDLAW, of the Department of Physiology of the University of Sydney, has been elected president of the Linnean Society of New South Wales for the current session.

PROF. RAYMOND A. DART, professor of anatomy in the University of the Witwatersrand, Johannesburg, has been elected a corresponding member of the Italian Society of Anthropology, Ethnology, and Comparative Psychology The society was founded in 1871 and the number of corresponding members is limited to ninety.

FURTHER information is now available with regard to the large earthquake which was recorded at Kew Observatory and other seismological stations on May 26. In a message which was broadcast on May 27, in code, from Arlington, the United States Coast and Geodetic Survey gives the position of the epicentre as in Lat 56° N, Long 137° W, that is, under the Pacific Ocean, about 100 miles from Sitka, Alaska. The time was 22 hr 40 min. G M.T., which is 14 hr 40 min. Pacific Coast time

BY kind permission of the director of the Rothamsted Experimental Station, Harpenden, a summer meeting of the Royal Meteorological Society will be held there on Wednesday afternoon, June 12 Fellows will make a general tour of inspection of the various departments, and will visit the classical field plots and the meteorological station, where a number of recording instruments are maintained.

AT the general meeting of the Imperial Academy of Japan, held on April 12, Sir Alfred Ewing was elected a foreign member. The president, in announcing this election, stated that the Academy most highly appreciated Sir Alfred's numerous and important contributions to science, and gratefully remembered his untiring efforts in promoting in Japan the spirit of studying science for its own sake when scientific study was just beginning to be pursued in that country half a century ago.

THE New York correspondent of the *Times* announces that Prof Henry Fairfield Osborne, president of the American Museum of Natural History, has secured from the Muller heirs in Sao Paulo, Brazil, the originals of an entire series of letters from Charles Darwin to the great German naturalist, Dr. Fritz Muller, with the view of sending them to be added to the memorial collection at Down House.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A science teacher for day and evening work at the Walker Technical College, Wellington, Shropshire — The Principal, Walker Technical College, Hartshill, Wellington, Shropshire (June 11). A lecturer in engineering at the Wigan and District Mining and Technical College—The Principal, Mining and Technical College, Wigan (June 12). A full-time assistant lecturer in pharmaceutical subjects, and a full-time lecturer in electrical engineering at the Leicester College of Technology — The Registrar, College of Technology, Leicester (June 19). An

adviser in agricultural chemistry in the University of Manchester—The Registrar, The University, Manchester (June 20). A lecturer in physics in the University of Durham (Durham Division)—The Head of the Department of Science, University of Durham, South Road, Durham (June 22). A lecturer in mechanical engineering at Armstrong College—The Registrar, Armstrong College, Newcastle-upon-Tyne (June 22) An assistant inspector under the Ministry of Agriculture and Fisheries for work in connexion with agricultural and horticultural education and research—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (June 24) Two assistant superintendents under the Geological Survey of India —The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W 1 (June 24). A director of the Bureau of Economic Research of the Commonwealth of Australia—The Official Secretary, Commonwealth of Australia, Australia House, Strand, W C 2 (July 1) A professor of Indian history and archæology in the University of Madras — The Registrar, University of Madras, Triplicane P.O., Madras (August 19). An instructor in engraving and etching, and an instructor in decorative composition and design in the new Higher School of Fine Arts, Cairo—The Ministry of Education, Cairo (Sept. 30). A chemist under the Air Ministry, Kidbrooke, with up-to-date knowledge of analytical methods, organic and inorganic chemistry, with specialised knowledge of one of the following subjects · (a) metallurgy ; (b) petroleum technology , (c) non-metallic aeronautical materials, i e. lubricating oils, dopes, paints, etc. ; (d) textiles , also a chemist with analytical experience in organic and inorganic work, and, if possible, specialised knowledge of metallurgical chemistry or petroleum technology—The Secretary (I.G), Air Ministry, W C.2. A supervisor for the scientific instrument testing department of W. G. Pye and Co.—W. G Pye and Co , Granta Works, Cambridge. A laboratory steward for the biochemical laboratory of University College, London—The Secretary, University College, Gower Street, W.C 1. A plant physiologist at the Welsh Plant Breeding Station, Aberystwyth — The Secretary, Welsh Plant Breeding Station, Agricultural Buildings, Aberystwyth. A laboratory assistant for the Health Department of the Government of Iraq—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/1546). A junior assistant at the Experimental Station, Porton—The Chief Superintendent, Chemical Warfare Research Department, War Office, 14 Grosvenor Gardens, S.W.1.

Our Astronomical Column.

MATTER IN INTERSTELLAR SPACE.—The existence of interstellar calcium, as evidenced by the detached [*H*] and [*K*] lines in stellar spectra, has for some time engaged the attention of Dr. O. Struve (see, for example, NATURE, vol. 122, p. 252). His latest researches, made in collaboration with Prof. B. P. Gerasimovič, and described in the *Astrophysical Journal*, vol. 69, p. 7, deal with the physical properties of calcium and other elements in interstellar regions. Eddington's hypothesis of an interstellar substratum embodying the whole galactic system is regarded as the most satisfactory hypothesis at present, and the one most in accordance with both observational data and theoretical considerations. This substratum consists of many elements in various states of ionisation, with an average density of the order of 10^{-26}. The observed intensities of detached Ca^+ lines show a definite distance effect, such as would be expected from a uniform distribution of Ca^+ with a density of about $3 \cdot 6 \times 10^{-32}$. The substratum of interstellar matter appears to share the rotational motion of the stars round a distant central mass in galactic longitude 325°.

THE SUNSPOT CYCLE AND THE CORONA.—It is about half a century since it was first noticed that the form of the corona varies with the progress of the sunspot cycle Our knowledge on the subject has become more definite from the aid afforded by the long series of coronal photographs that is now available. Recently, studies on the subject have been made by Profs. H. Ludendorff and S. A. Mitchell. The latter contributes an article to *Popular Astronomy* for April, which discusses and amplifies Ludendorff's conclusions. The ellipticity of the corona near the sun's limb is denoted by a, that at a distance of one radius from the limb by $a+b$; a varies very little with the sunspot cycle, its mean value being 0·04 , b is zero at maximum sunspot activity and about 0·26 near minimum activity ; it appears, however, to reach its maximum a year or two before sunspot minimum. Mitchell notes that the coronal spectrum appears also to change its type ; thus the line at λ6374 in the red, which is not often observed, was well seen both in 1914 and in 1925, these being at the same phase of the cycle. It is suggested that the Wolf numbers are a better guide to the type of corona than the phase of the sunspot cycle ; it is also noted that the corona of 1918 was abnormal , it occurred a year after sunspot maximum, and had most of the features of maximum type, but there were also the strong polar brushes associated with minimum type.

OCCULTATIONS OF STARS BY VENUS —*Acta Astronomica*, series A, vol. 2, contains a discussion by J. Witkowski of the occultations of three stars by Venus. That of the star BD - 0° 2554, mag 7, was observed at Teramo on Nov 9, 1895 This had not been predicted, and was observed by chance. Prof. T. Banachiewicz predicted that of the 4th magnitude star η Geminorum on July 26, 1910 ; it was observed at seven observatories. Dr. L. J Comrie predicted that of BD + 18° 1499, mag. 7 4, on Aug. 22, 1924. Both phases were observed at Neu-Babelsberg, and the reappearance at Bergedorf.

From discussion of these phenomena Mr Witkowski finds a correction of $-0\,58'' \pm 0\,23''$ to Hartwig's value of the diameter at distance 1, which is 17 552″. This is in fair accord with Auwers's value 16 820″ derived from the transits of Venus in 1874 and 1882. He finds corrections to the *Nautical Almanac* positions of Venus which agree fairly well with those found with the Greenwich Transit Circle The observations lead him to suspect some refraction of the stars due to the atmosphere of Venus.

Research Items.

SECRET SOCIETIES AND THE BULL-ROARER.—Mr. Edwin M. Loeb, in a study of tribal initiation and secret societies (*University of California Publications in American Archæology and Ethnology*, vol 25, No 3), makes a world-wide survey of the evidence and reviews the theories of previous writers on these features of social organisation The tribal initiations fall into two classes, those which are exoteric, that is, those to which all members of the tribe are subject, but in which no attempt is made to preserve secrecy as to details, and the esoteric, of which the detailed rites are kept secret It is out of these latter that the secret society grows, the distinctive feature being that they are exclusive Secret societies are not, as in the opinion of certain writers, to be connected with the matriarchate, and though totemism and the sib system attach themselves to secret societies in certain areas, tribal customs and secret societies belong to an older stage of social organisation than either It is noted that while boys' initiations are tribal, that of girls is a family matter Both boys' and girls' initiations are common among backward peoples They occur among Negroids and Australians and regionally in the New World, but are lacking among other Mongoloids, and also among Caucasians, with the doubtful exception of the 'mysteries' of ancient Greece. From the distribution it is inferred that these traits are of archaic, possibly palæolithic, origin, and not a matter of recent diffusion As regards the bull-roarer, earlier theories are to be regarded as untenable. It would be possible to regard it as of independent origin in different regions only if attention were confined to its use as a toy or for purposes of magic. In connexion with initiation and secret societies, it is always associated with a form of tribal marking, a death and resurrection ceremony, and an impersonation of ghosts and spirits It is tabooed to women and is invariably represented as the voice of spirits; but when found outside the area of initiation rites and secret societies it is neither. As there is no psychological principle which debars women from the sight of the instrument in Oceania, Africa, and the New World, it cannot be regarded as due to an independent origin and it must be inferred that it has been diffused from a common centre

ANTAGONISM BETWEEN TUBERCULOSIS AND CANCER.—From a statistical survey of the incidence of cancer (carcinoma and sarcoma) among tuberculous and non-tuberculous individuals, Prof. Raymond Pearl concludes that there is a marked and definite incompatibility or antagonism between the two diseases (*Amer. Jour. of Hyg*, **9**, 97; 1929) Active tuberculous lesions were found at autopsy in only 6·6 per cent of 816 persons having malignant growths, and in 16·3 per cent of 816 persons without malignant tumours, but of the same race, sex, and age as the former group. In 886 persons of both sexes and races compared, who were the subjects of active tuberculous lesions, there were but 11 cases of malignant tumours, or 1·2 per cent of the total number, but in a similar group of 886 persons with no recorded tuberculous lesions there were 82 cases of malignant tumours, or 9·3 per cent It is only when *active* tuberculous lesions are present that the antagonism seems to exist, for *healed* tuberculous lesions occurred with equal frequency in the malignancy and control groups.

BREEDING AND MIGRATIONS OF THE ELEPHANT SEAL.—The two species of seals which we have had opportunities of studying in British waters have distinct but well-defined and compact breeding periods. It is curious that the elephant seal (*Macrorhinus leoninus*) should have so diffuse a breeding period, but the evidences collected by M E. McLennan Davidson leave the matter in no doubt (*Proc Calif. Acad. Sci*, vol 18, April 1929) On Juan Fernandez young seals have been found from June 10 to Sept. 19; on Guadaloupe Island on Oct. 9, Mar 5, and May 8; and on the Lower Californian Islands from Nov. 1 to Feb. 1. That is to say, young of the elephant seal have been found in practically every month of the year, although a certain allowance must be made for the fact that the young seals recorded were not in every case new born Rothschild considered that a regular migration of the adult seals took place to the Chilian coast and the islands near (Juan Fernandez, etc), but various facts suggest that such a migration is improbable. Elephant seals have been found in the Antarctic pack ice in January, pointing to a movement away from, rather than across, the equator, and the evidence of a prolonged breeding season, as well as the presence of a considerable herd of elephant seals in North American waters during all seasons, also tell against the possibility of a migration to Juan Fernandez

THE EUROPEAN STARLING IN NORTH AMERICA—Several attempts were made to establish the European starling in the United States before a successful introduction was made in 1890 at New York City By 1896 it had become firmly established in this area, and since that time its spread has been so rapid and its hold upon the country so secure that it must now be regarded as a naturalised member of the North American fauna Within twenty years it had become one of the most abundant birds in the region about New York City and of local occurrence from Maine to Maryland. In another dozen years it had occurred in every State from the Atlantic to the Mississippi, and from the Ottawa and St Lawrence Rivers in Canada to the Gulf of Mexico, with outlying records in Nova Scotia, Iowa, Missouri, Kansas, and Texas. The conquest has been viewed with some concern It can scarcely be doubted that so great numbers of a new-comer must affect adversely the numbers of native birds, and it tends to drive some away from the vicinity of houses by ousting them from nesting sites On the whole, the starling's feeding habits are probably beneficial, but the greatest danger arises from its custom of gathering in enormous flocks after the breeding season, so that harm is caused by over-concentration in crop areas or from the insanitary habits of the birds (May Thacher Cooke, in *U S. Dept Agr. Circular*, No. 40). These are complaints which have been proved against the birds in Great Britain.

MALARIA MOSQUITOES OF SOUTH AFRICA—In Publications of the South African Institute for Medical Research, vol 4, 1929, pp. 83-170, Messrs Alexander Ingram and Botha de Meillon contribute the second part of a "Mosquito Survey of certain Parts of South Africa, with Special Reference to the Carriers of Malaria and their Control". It deals with survey work carried out in the eastern and northern Transvaal during a portion of the malarial season, which is considered to last from January to May The two recognised carriers of malaria in South Africa —*Anopheles funestus* and *A gambiæ*—differ essentially in their breeding habits. *A. funestus* prefers the edges of slowly running streams, which are in deep shadow, for oviposition, while *A. gambiæ* resorts to shallow pools or puddles exposed to sunlight *A. gambiæ* shows a decided seasonal prevalence, whereas *A*

funestus does not appear to exhibit this feature. It is because *A. gambiæ* is much the more numerous of the two species during the malaria season that the authors regard it as the main malaria carrier. They consider that concentration upon the reduction in numbers of this insect is more likely to bring about a diminution of malaria than an indiscriminate attempt against Anophelines in general. The paper includes detailed descriptions of the larvæ and pupæ of certain South African mosquitoes not hitherto described, and these descriptions are accompanied by 28 illustrations.

LUMINOUS SQUIDS.—M. Ishikawa (*Proc. Imp. Acad. Sci.*, Tokyo, January 1929) describes *Abralia japonica*, a new species of luminous squid from the Sea of Japan The total length of the squid is 116 mm Numerous minute luminous organs, as dark bluish dots with a paler opaque lens in the centre, are distributed over the ventral surface of the mantle, head, funnel, and the ventral and third arms. On the ventral periphery of the eye are five circular luminous organs, brownish-orange in colour, visible through the outer integument which covers the eye. T Kishitani (*Proc. Imp. Acad Sci*, Tokyo, December 1928) gives a preliminary account of the pair of luminous organs of *Loligo edulis*, which are sunk in the ink sac, one on each side of the rectum. The author has found a coccobacillus in the tubules of the gland tissue which forms the luminous part of the organ, and records the cultural characters of the organism and its action on sugars.

RUST RESISTANCE OF WHEAT.—The resistance of wheat to leaf rust, *Puccinia triticina*, has generally been regarded as a definite, heritable, and relatively stable character. However, several workers have recently demonstrated that differences in external conditions, such as the variation between growth in the field and in the greenhouse, may have an important bearing on the crop's resistance to this disease. C. O. Johnston and L. E Melchers have now shown (*Journal of Agricultural Research*, **38**, p 147) that under greenhouse conditions the age of the wheat plant is frequently an all-important factor in determining whether or not infection shall occur. A number of different wheat varieties were tested by inoculations with rust at three distinct stages of growth, after one month, as the period of winter dormancy was just ended and also when the head had fully emerged. Whereas some varieties changed but little in their reaction to the disease, remaining susceptible or resistant throughout their growth period, others showed a definite alteration in their reaction according to their age. Resistance, however, invariably increased towards heading time. From the plant-breeder's point of view, this affords a ready means of testing new varieties, since if resistant in the seedling condition, resistance is assured at all later stages of growth. Thus new hybrids which appear promising but are really worthless on account of their susceptibility to rust may be discarded by means of this simple test before time has been wasted upon them. Wheats showing an increase in resistance with age also showed a variation in the degree of susceptibility of their leaves. The higher the leaf on the stem the greater its resistance to rust, from which the authors suggest that the change in the plant's reaction to the disease is probably correlated with some chemical or physiological change in the leaf.

GREEN ALGÆ OF THE SEA OF JAPAN.—The Pacific Scientific Fishery Research Station in Vladivostok just published in its *Bulletins* (vol. 2, part 2, 1928) a paper by E. S. Sinova on the Chlorophyceæ of the Sea of Japan. The work is based on numerous collections made by many Russian expeditions since 1870 and preserved in the Botanical Gardens and the University of Petrograd, as well as on the personal observations by the author in 1926. The sea bottom is mainly rocky, and the rocks are covered by a continuous carpet of seaweeds The salinity of the water near the mouth of rivers is 32-33 per mille, and the principal genera of algæ present there are *Scytosiphon*, *Punctaria*, *Ulva*, and *Laurencia*. All the rocky grounds in the northern part of the Bay of Peter the Great are overgrown by the ‘ sea-cabbage ’, *Laminaria japonica*, which reaches gigantic dimensions and covers very large areas of the bottom. This seaweed forms a basis of a very important industry, since more than 15 million pounds of the dry weed are exported annually to China for food and for technical purposes. *Sargassum* and *Cystophyllum* occupy large stretches of the bottom, while *Zostera japonica*, *Z marina*, and *Z. pacifica* form such dense colonies that navigation is made difficult in places. Three new forms of *Laminaria japonica* are described, and *Ceramium subverticillatum* (Grun.) Web., described from New Caledonia, is recorded for the Sea of Japan for the first time A parasitic seaweed, *Streblonema* (*Ectocarpus*) *parasiticus* (Sauv.), occurs abundantly on *Ceramium cubrum* (Huds) Ag , *Gracilaria confervoides* (L) Grev , and on *Camphœlophora hypneoides* J. G Ag.

DATA ON TERRESTRIAL MAGNETISM.—The March issue of *Terrestrial Magnetism* contains a wide variety of articles on theoretical and observational aspects of the subject ; the diamagnetic theory of the daily magnetic variation is discussed by its author, Ross Gunn, and by S. Chapman, and the density and other conditions in the outer atmosphere are described in an interesting speculative paper by H. B. Maris. Hafsted and Tuve report observations, by means of wireless echoes, of abnormal changes of height of the reflecting ionised layer in the upper atmosphere during magnetic storms. There is also a list of preliminary values of the ocean magnetic determinations made by the non-magnetic ship *Carnegie* on its voyage from Balboa to Easter Island and Callas, October 1928 to January 1929 ; the promptness of publication of such observations is a matter on which the Department of Terrestrial Magnetism of the Carnegie Institution of Washington can feel just pride.

LUMINOSITY OF THE NIGHT SKY.—The Australian Commonwealth Solar Observatory has issued its first publication (*Memoirs*, vol. 1, No. 1), entitled “ The Luminosity of the Night Sky ”. It describes the observations made with a Rayleigh night-sky photometer during 1926 and 1927, first at Canberra, and later at Mount Stromlo, about seven miles away The green auroral light has high values in March and April, whereas in England the maximum is in October ; in each case there is a suggestion of a second maximum near the other equinox. Dr Duffield, the director, found that the blue part of the spectrum was likewise unusually intense near the equinoxes, and attributes this to nitrogen bands such as occur in the spectrum of polar auroræ, themselves specially frequent at these seasons : hence he supposes that the equinoctial maxima of the green auroral light are due to polar auroræ. At other times of the year, though there is an excess of green auroral light over that to be found in diffuse light from the sun or moon, there is no evidence of excess blue radiation. He therefore accepts Rayleigh's distinction between polar and non-polar auroræ. The period of observation, two years, is too short to indicate whether there are changes of the night-sky light associated with the sunspot epoch, and it is greatly to be hoped that these southern observations will be continued for several years.

THERMO-ELECTRIC PROPERTIES OF METAL CRYSTALS.—The February issue of the *Proceedings of the American Academy of Arts and Sciences* contains an account of Prof. P. W Bridgman's investigations of the resistivities and thermo-electric properties of rods of metal from a single crystal which he has carried out with aid from the Rumford Fund. The rods, 8 cm long and 0 3 cm. diameter, are obtained by slow cooling from below upwards of a number of connected glass tubes inclined at different angles to the vertical, and filled with the molten metal The whole contents of the tubes are then parts of a single crystal The resistivities of rods of zinc, cadmium, antimony, tin, and bismuth, inclined at various angles to the crystalline axes, were found to follow Kelvin's law that they should be linear functions of the square of the cosine of the angle of inclination When each rod was soldered between copper leads and the junctions kept at different temperatures, the thermal electromotive forces were found to follow the same law, with deviations in the cases of tin and bismuth which are greater than the possible experimental error.

RECOMBINATION SPECTRA —A neat experimental method for investigating the neutralisation of positive ions by free electrons has been described by Dr F L Mohler and C Boeckner in the March issue of the *Journal of Research* issued by the U S Bureau of Standards During the recombination, continuous spectra are emitted in the form of bands shaded to the violet, with their heads close to fundamental lines in the arc spectra of the resulting neutral atoms. The distribution of intensity in the individual bands can be determined photometrically, and at the same time the concentrations of the ions and electrons, and the average thermal energy of the latter, can be found by the probe-wire method of Langmuir and Mott-Smith; by combination of the electrical data and the optical data it is then possible to calculate the chance that a slow electron of specified speed shall fall into any one of the more important unoccupied orbits of the atom in question An outstanding feature of this work is that it confirms the somewhat surprising conclusion which had been arrived at from the study of the positive column of mercury arcs, that even under favourable conditions recombination in the gas phase is a relatively rare event. The discharge tubes used by Dr Mohler were of a very simple type, being in fact almost identical with gas-filled wireless valves containing helium or cæsium vapour, and operated in the 'blued' state.

SINGLE CRYSTALS OF SILVER —Single crystals of various metals have been prepared in the form of rods or wires, and Hauser has obtained etch patterns, showing the crystallographic form, on spherical single crystals of copper and silver The first preparation of large single metallic crystals possessing the characteristic external form appears to be that carried out in the case of silver by Steacie and Toole and is described in the *Journal of the American Chemical Society* for April The metal is fused in the absence of air, cooled slowly and then kept at 940° for two days. Dilute nitric acid attacks the faces of the single crystal thus obtained in a specific manner resulting in the formation of a prismatic crystal

GERMANIUM DICHLORIDE —The preparation of germanium dichloride, by passing the vapour of the tetrachloride, free from hydrochloric acid, over metallic germanium at about 430°, is described by Dennis and Hunter in the *Journal of the American Chemical Society* for April. Germanium dichloride is a pale yellow solid which is instantly decomposed by moisture and is slowly acted upon by dry oxygen in accordance with the reaction: $2GeCl_2 + O_2 = GeO_2 + GeCl_4$ It readily dissociates on heating, and hence cannot be purified by sublimation. Germanium dichloride is unaffected by alcohol and chloroform but is hydrolysed by water, ammonium hydroxide solution converts it into an orange-coloured substance

APPARENT INFLUENCE OF AN ELECTRIC FIELD ON THE BOILING POINT OF BENZENE.—It has been shown by Baker that when an electric field is applied to benzene in a tube heated by an oil bath, the boiling point, as registered by a thermometer in the liquid, appears to be considerably raised The same effect was later observed by Smits, who showed that the vapour pressure remains unchanged and that if the heating is carried out directly with a flame the liquid boils at the normal temperature. Smits attributed the phenomenon to superheating rendered possible by the removal of charged dust particles by the field. In the *Journal of the Chemical Society* for April, J W. Smith describes experiments which show that the effect is very much reduced by vigorous agitation of the benzene, and when ebullition has commenced before the application of the electric field, then the boiling point remains unaltered In all cases the vapour temperature has the normal value The explanation advanced by Smits appears, therefore, to be correct

LANOLINE RUST PREVENTERS —The Department of Scientific and Industrial Research has recently published an account (Engineering Research, Special Report, No. 12. London: H M. Stationery Office) of an investigation of rust-preventing mixtures carried out at the National Physical Laboratory. Preservatives of a greasy nature are more satisfactory than hardening paints or varnishes, and the best results were obtained from lanoline, either brushed on to a steel surface or deposited from solution. Such coatings have very great adhesion to steel even at high temperatures. Benzene is the best solvent to use for making up the lanoline solutions, but solvent naphtha is more suitable for industrial use and is quite satisfactory. Harder coatings can be obtained by the addition of paraffin wax or ceresin, and if the solution is coloured, breaks in the film may readily be detected

DENICOTINISED TOBACCO —An account of the so-called 'denicotinised' tobacco is given by E. M. Bailey and others in the Report of the Connecticut Agricultural Experiment Station for 1927 (*Bulletin* 295). Many of these tobaccos are now on the market bearing the advertisement that the bulk of their nicotine has been removed, from which the consumer naturally concludes that the product has been rendered harmless Actual analyses, however, revealed the fact that on an average only one-half to one-third of the nicotine is removed in the re-sweating process. Further, since the percentage of nicotine varies enormously in different tobaccos, it is possible for a 'denicotinised' product to show as high a nicotine content as some other untreated tobaccos. For example, the lowest percentage of nicotine found in a treated tobacco was 0·75, but certain types of Havana, Porto Rican, and Turkish tobaccos normally contain as little as 1 per cent. From this it is clear that unrestricted indulgence of these tobaccos by people who suffer ill effects from nicotine is unwarranted. The authors conclude with the suggestion that methods may be found which entirely remove the nicotine, though they raise the obvious query whether such refined tobacco would retain the qualities for which smoking is enjoyed.

New Mining Department at Armstrong College, Newcastle-on-Tyne.

ON May 14, H.R.H. the Prince of Wales opened the new Mining Department of Armstrong College In his opening speech he said, "The industry is confronted with stern competition from overseas. It must be equipped to meet that competition, and I think it is generally agreed that it is to science that we must look in our distress Science must show the way to an improvement in our methods, and scientific training must be available both for the leaders and the rank and file, so as to ensure that no single ounce of energy is lost in the tug-of-war against our competitors."

The demand that Armstrong College should intensify and enlarge its share of work of scientific research in the interests of the coalfields it mainly serves has recently become specific The coal owners of Durham and Cumberland, the Federation of Iron and Steel Manufacturers, the Department of Scientific and Industrial Research and the coke and gas industries, have co-operated with the College in the formation of a committee to supervise and encourage the prosecution of researches bearing directly on their respective industries. This work is now well in hand, valuable reports have already been issued, and more may be confidently expected in the near future. Similar co-operation between the College and the Fuel Research Board has begun: a physical and chemical survey of the coal seams in the northern coalfields is in progress, the chief purpose being to obtain an exact knowledge of the properties of these seams. This work is being carried out at present in temporary buildings, but it will shortly be transferred to the top floor of the new building

The Department of Mining in Armstrong College has long and fine traditions behind it. It forms the oldest mining school in Great Britain, for it dates back in one form or another to the year 1837. Many of the foremost men in the mining industry to-day received their training in it The present head of the Department is Prof Granville Poole, who has designed the new building which now provides adequate facilities for the teaching of mining and the prosecution of research.

The erection of this building has been made possible only by generous grants from the Miners' Welfare Fund. The sum of £20,000 was subscribed by the Central Committee of the Fund and £10,000 from the Northumberland District Committee. Anonymous donors have contributed nearly £5000 to the equipment of the building and a further sum of £15,000 is required. The building will occupy a central position when the general scheme for the development of the College is completed The architect is Mr. Dunbar Smith, of London, who was also the architect for the new College Library and for the National Museum of Wales, one of the noblest buildings erected in Great Britain within recent years.

Apart from the rooms set apart for research, the Department has several prominent features, for example, an exhibition hall containing plant and models of great educational value, and products from modern carbonising and hydrogenating plants, etc, also a specially equipped laboratory housing plant for the dressing of minerals.

The courses of the Department are arranged to meet the requirements of those who wish to specialise in any branch of mining, and the diploma and degrees obtainable are accepted by the Board for Mining Examinations in lieu of two years' practical experience in a mine

Insect Nutrition and Metabolism.

THE subject of nutrition and metabolism in insects is highly important, in that its adequate exploration is likely to provide fresh viewpoints for problems of insect control. At the same time its relation to such insect products as silk, lac, honey, and wax should not be overlooked. At the present time, knowledge of the metabolic processes of insects is limited to scattered experiments and observations, usually confined to individual species, and of too inadequate a character to admit of reliable generalisations being made The literature is very extensive and, for that reason, imparts the impression that a large amount of work has already been accomplished. A survey of any small branch in this field will, however, reveal how much of the available information is of a comparatively trivial or incomplete character, and what an infinitesimal amount of really fundamental knowledge has, so far, been gained

In the *Transactions of the Entomological Society of London*, 1928, Part 2, Mr B P. Uvarov, senior assistant in the Imperial Bureau of Entomology, has brought together the results of all the work done on the subject of insect nutrition and metabolism His memoir takes the form of an admirable introductory survey (65 pp.) of the range of problems involved, together with a bibliography of nearly six hundred titles. In the collation and examination of so large a mass of literature, the author has done a substantial service to entomology and laid the basis and provided a guide for future research.

If one selects, for example, the enzymes involved in the digestive processes of insects, rather a surprising amount of data will be found available, but much of the material is the result of old, or of imperfect, methods of technique. There is also the fact that the part played by micro-organisms living in the digestive tract further complicates the subject The need for clearly ascertaining which enzymes are produced by the insect and which by micro-organisms of symbiotic or other relationship is abundantly evident. With plant-sucking insects we have evidence that they are capable of converting starch into sugars, but we know nothing concerning their utilisation of the protein constituents of cell sap Buchner went so far as to conclude that the symbiotic micro-organisms of aphids, coccids, etc, are able to utilise atmospheric nitrogen and so make up for a supposed deficiency in nitrogen absorbed by such insects from their plant hosts It is, however, abundantly clear that there is no positive evidence indicating that sucking insects do not obtain and utilise all the nitrogen they need from the cell contents we have to admit that the rôle of the symbionts is still unsettled.

Again, the problem of cellulose digestion in insects is very far from being settled in spite of the existence of tens of thousands of plant-feeding species. The presence of a cellulase has been found in very few insects and, for the vast majority of species, it would appear probable that, if cellulose is digested at all, it is by the intervention of micro-organisms, as has been so well demonstrated by Cleveland in the case

of termites. We know surprisingly little concerning the nutritional requirements of blood-sucking insects which are concerned with the transmission of the pathogenic agents of certain virulent diseases. We need to know the length of time such insects can exist in the absence of a blood meal, the extent to which digestion of blood requires the interaction of micro-organisms, the influence of different types of blood upon fecundity, and the extent to which the selection of one mammalian host in preference to another is a chemical or a biological problem

These few comments will serve to indicate the nature and importance of some of the problems involved It is to the credit of the Dietetics Subcommittee of the Civil Research Committee that it directed attention to the need for examination of the nutritional problem in insects Through the Empire Marketing Board it was able to arrange with the Imperial Bureau of Entomology to produce a collated bibliography of the whole subject, and Mr. Uvarov's memoir was the result On the submission of the MS to the Civil Research Subcommittee, the latter body approached the council of the Entomological Society of London, through the Empire Marketing Board, with a view to its publication. It must be added that the financial provision was made by the Empire Marketing Board, and that it affords yet another example of the breadth of view and wise foresight exercised by that Board in the furtherance of applied biological research.

The inception, preparation, and publication of this memoir reflects the greatest credit on all concerned. It may be added that Mr. Uvarov's actual summaries of the papers listed in his bibliography have been deposited in the Reid Library of the Rowett Research Institute for Animal Nutrition, Aberdeen Arrangements have also been made for a set to be placed in the Science Library at South Kensington, where they will likewise be available for consultation. A limited number of copies of Mr Uvarov's memoir are available on application to the Secretary, Committee of Civil Research, 2 Whitehall Gardens, S.W 1. A. D. IMMS

Annual Visitation of the Royal Observatory, Greenwich.

AT the annual visitation of the Royal Observatory, Greenwich, by the Board of Visitors on Saturday, June 1, the Astronomer Royal presented his report, which describes the work of the observatory during the year ended on May 10 The observations with the transit circle numbered nearly nine thousand, embracing the sun, moon, planets (of which special attention was paid to Vesta, owing to its value for determining the equator point), fundamental stars, and stars needed for comparison with Eros at the time of its near approach to the earth in 1930–31 The correction to the longitude of the moon as calculated from Brown's tables is $+5\cdot51''$ from the limb and $+5\cdot83''$ from the crater Mosting A The correction has been diminishing at the rate of a third of a second per annum since Brown's tables were introduced into the almanacs in 1923. The early observations of the sun and moon, from 1751 onwards, have been re-reduced, it is found that the longitudes deduced from the declinations are more trustworthy in the early years than those from the right ascensions The results give support to the theory that there are variations in the earth's rate of rotation, they also indicate a secular acceleration of the sun's longitude, the amount of which is $+0\cdot78''$ in a century

Observations with the Cookson Zenith Telescope show that the variation of latitude in recent years has been abnormally small, the large amplitude of seven years earlier has not been repeated

The 28-inch equatorial has been used for double star observation, 282 stars have been measured during the year, 44 of which are separated by less than half a second, a new working list of some 2000 pairs discovered by Dr. Aitken has been prepared The old water-clock used for driving this instrument, and its predecessor the Merz equatorial, since Airy's days has been superseded by an electric drive of the Gerrish type, which was on view for the first time at the visitation. The Astronomer Royal gratefully acknowledges the help given in preparing the plans by Mr. F. J. Hargreaves, who had used a similar drive successfully on his small equatorial at Kingswood, Surrey. It was with this instrument that he was the first to photograph the comet Grigg-Skjellerup at its return in 1927

Thirty-one stellar parallaxes were determined with the Thompson 26-inch equatorial during the year, bringing the total up to date to 400. A useful economy has been introduced of taking two parallax fields on the same plate, this halves the time spent in development

The 30-inch reflector is being used for the determination of 'colour temperature' of stars The absolute temperatures are obtained by comparison with the positive crater of a carbon arc lamp, which is mounted on the roof of the octagon room, 600 feet away. Twenty-four early-type stars, distributed as uniformly as possible round the northern hemisphere, have been selected as standards, forty other stars have now been compared with these, the comparisons being made at the same altitude in each case. Some notes on B-type stars of abnormally low temperature were published in the *Monthly Notices* last year.

With the astrographic equatorial, plates are being taken for comparison with those taken twenty-five to thirty years ago, in order to determine proper motions The result of this study for the zones from Decl. $+64°$ to $+72°$ is now in the press. The sunspot curve gives indications of a double peak, in 1926 and 1928 respectively Daily spot numbers, both of the whole disc and of the central region, are sent to Zurich for the Bulletin which is published there under the auspices of the International Astronomical Union.

The magnetic elements determined at Abinger for the year 1928 are Decl. 12° 47·0′ W., Hor. Force, 0·18564, Vert. Force, 0·42941, Dip, 66° 37·3′, the Decl. is diminishing about 12′ per annum.

The mean temperature of the year ending on April 30, 1929 (misprinted 1928 in the report), was 48°·7, or 0°·8 below the average Frost occurred on 71 days, the rainfall was 20·46 inches, or 3·78 below the average. March, with 0·038 inch, was the driest month ever recorded at Greenwich.

The performance of the two Shortt sidereal clocks has been very satisfactory, the temperature in the clock cellar is now maintained at 62°·8 Fahr The progressive increase of losing rate still continues, it is proposed to substitute a bob of invar on one of the clocks

Daily comparisons of time are made with Paris, Nauen, Annapolis, and Bordeaux. In all four cases the residuals appear to show an annual wave

Allusion is made to the eclipse expedition to Kedah and Siam. The total equipment weighed ten tons. Unfortunately, no results were obtained in the investigation of the Einstein bending of light, but some results on the corona and prominences were obtained at Alor Star. A. C. D. CROMMELIN.

Wisconsin Limnology.

THE veteran limnologist, Dr. E. A Birge, together with Dr Chancey Juday and other collaborators, has made several additions to the detailed study of Wisconsin lakes in the *Transactions of the Wisconsin Academy*, vol. 23, *Proceedings of the American Philosophical Society*, vol. 66, and in *Ecology*, vol. 8 The Academy papers deal with the temperature of the bottom deposits of Lake Mendota, with the chemical composition of its larger aquatic plants and with the phosphorus content of that and other Wisconsin lakes. Temperatures were measured in the mud of Lake Mendota down to 5 metres, in depths of water from 8 m to 23 5 m. The data accumulated are used to calculate the annual heat-budget At the shallowest station this amounted to 2950 calories per sq. cm and 1100 calories at the deepest. Preliminary data on the heat-budget of Karluk Lake, Alaska, are given in *Ecology*, July 1927. These are compared with the values given by lakes in Central Europe.

Supplementing a previous study of the composition of *Cladophora* and *Myriophyllum*, analyses of *Vallisneria* and *Potamogeton* are now given. Rickett had previously shown that Mendota, 10 4 sq. kilometres in area, yielded, in dry weight, 1112 metric tons of *Potamogeton* and 736 of *Vallisneria*. Of these, the latter has an ash content of 25 2 per cent, the former 11 4 per cent. Their influence upon the water and soil of the lake must, therefore, be very considerable The analyses are unusually detailed and record the amounts of certain important minor constituents, such as phosphorus, iron, manganese, and silica, which are frequently omitted.

The organic matter content of lake waters is considered in a preliminary survey (*Amer Phil. Soc*), which, however, contains analyses from forty-four lakes. These are grouped into *autotrophic*, which derive their organic matter from internal sources only, namely, from the phytoplankton and attached vegetation, and *allotrophic*, into which drainage brings soil and marsh extractives. For each lake the organic matter is a fairly definite quantity, showing no great variation either with depth or time. This is in striking contrast to the oxygen content, which is often greatly reduced in the deeper cold water, the hypolimnion , this during summer remains unmixed with the warm epilimnion.

Analyses were made of the waters of eighty-eight lakes to determine the soluble phosphorus existing as phosphate, also the phosphorus in organic combination. This was done in order to ascertain whether the simple yearly cycle, observed in the open sea, could also be traced in these lakes. The marine workers found a winter maximum and a minimum in early summer, lasting until August, the surface waters being, during the summer, almost or quite devoid of inorganic phosphorus, and the deeper waters—in shallow seas—being much reduced. In the lakes, however, observations made in May, soon after the disappearance of the ice, and in July or August, were complicated by two factors—the very minute amount of inorganic phosphorus and its regeneration from the plankton. Accordingly, no such simple seasonal cycle was revealed. Possibly the rate of regeneration, rather than the absolute amount of phosphorus, may here be the limiting factor.

In *Ecology* (8, No. 4 , 1927) an account is given of the occurrence of two crustacea, *Pontoporeia affinis* and *Mysis oculata* var. *relicta*, which are regarded as 'marine relicts'. Though thoroughly studied in Europe, their American distribution is imperfectly known. It was found that *Pontoporeia* occurs chiefly in the hypolimnion, where the supply of oxygen may fall below 1 c c per litre The breeding season extends from December to May *Mysis* was found in two lakes During summer it remains on the bottom during daytime, but may even reach the surface at night The breeding season extends from October to May.

University and Educational Intelligence.

CAMBRIDGE.—The solicitors carrying out the will of the late Mr. John Humphrey Plummer state that, in view of the many conflicting and wholly unauthorised statements that have appeared, the time has arrived when some authoritative statement should be made concerning the benefaction which will accrue to the University The residue of the estate is to be applied in perpetuity for the promotion and encouragement of education in chemistry, biochemistry, physical science, or such other allied subjects in the University as the trustees shall think fit. The testator further expressed his desire and intention that his trustees should, as soon as possible, establish and endow a professorship or professorships, each of the annual value of £1200 in accordance with a scheme to be devised The testator further expressed the wish that the trust should be known as the John Humphrey Plummer Foundation. The trustees are advised that the estate should yield an income to the University of approximately £10,000 a year

The Drapers Company has made a grant of £1000 per annum for a further period of 10 years to the School of Agriculture

Dr. H B Roderick and Mr G Stead have been reappointed University lecturers in medicine

EDINBURGH.—Principal Sir Alfred Ewing announced at the meeting of the University Court on May 27, in connexion with the proposed internal reconstruction of the medical buildings at Teviot Place, that gifts have been intimated for this purpose of £20,000 from Sir William Dunn's trustees, and £35,000 from the Rockefeller Foundation, making a sum of £55,000 in all. This, along with other moneys available, now secures the carrying out in its entirety of a scheme drawn up by Mr Balfour Paul, architect, in consultation with the heads of the departments concerned, whereby the medical buildings, erected in 1880, will be radically altered in their internal arrangements, so as to bring them in line with the most modern requirements for teaching and research The external aspect of the buildings, as designed by the late Sir Rowand Anderson, will remain unaltered. The work will be begun in the summer vacation. Certain portions of the reconstructed building will in future be associated with the name of Sir William Dunn in recognition of the generous gift from his estate.

LONDON.—The following doctorates have been conferred: D Sc. in metallurgical chemistry on Mr. J. C. Hudson (Imperial College, Royal College of Science, and Royal School of Mines), for a thesis entitled "Third (Experimental) Report to the Atmospheric Corrosion Committee (of the British Non-Ferrous Metals Research Association)"; D Sc. in agricultural chemistry on Mr. V Subrahmanyan (Rothamsted Experimental Station), for a thesis entitled "Biochemistry of Waterlogged Soils".

MANCHESTER —Mr. J. B. M. Hay, lecturer in engineering, has resigned on his appointment as head of the Civil Engineering Department in Bradford Technical College

Applications are invited for two Grisedale biological scholarships in, respectively, botany and zoology, each of the value of £200. Applications should reach the registrar by at latest June 22.

Reading.—Dr. T. Franklin Sibly, principal of the University of London since 1926, has accepted the invitation of the council to become vice-chancellor of the University in succession to Dr. W. M. Childs, who is retiring in September next.

At the time of going to press, the following results of Parliamentary elections in University constituencies have been announced:—Cambridge (2) Mr J. J. Withers, Mr. G. H. A. Wilson. London: Dr E. Graham Little. Combined English (2) Sir Martin Conway, Miss E. Rathbone. Wales · Mr E. Evans. Queen's, Belfast. Col T. Sinclair.

The New Education Fellowship (English section) gives prominence in its annual report for 1928 to the subject of parent education. At a conference which it called last September, it was resolved to form a National Council for Parent Education and Child Study, and a provisional committee was appointed with Dr. Basil Yeaxlee as chairman to undertake the preliminary work with the aim of correlating and extending the efforts of existing organisations for forming parent-teacher associations all over Great Britain, child-psychology study groups, training of study-group leaders, publication of pamphlets and magazines for parents, formation of libraries, panels of speakers, etc The movement will be stimulated by a visit to Great Britain this summer of some of the leaders for similar movements in America and by the fifth international New Education conference to be held at Elsinore on Aug 8–21. The Fellowship, of the English section, of which Sir Michael Sadler is president, besides organising biennially international conferences, maintains libraries and information bureaux, publishes magazines, and in other ways promotes co-operation between educationists and between parents and teachers Its watchwords are Release spiritual and creative power in the child, study and respect the child's individuality; educate through innate interests; encourage co-operation rather than competition; co-educate, educate for service The general theme of the Elsinore conference will be "The New Psychology and the Curriculum".

A census of graduate research students in chemistry in the United States in 1927 shows that they numbered 1934 in one hundred and forty universities, as follows: in organic chemistry 570, general and physical 430, industrial and engineering 183, physiological 134, inorganic 116, agricultural 89, colloid 79, analytical 75, nutrition 58, catalysis 28, food 27, sanitary 25, photographic 25, metallurgical 21, five other sub-heads 74. The census has been taken annually for four years by the Research Information Service Division of the National Research Council, Washington, and discloses a steady growth in the total number of such students (1700, 1763, 1882, 1934), although under the various sub-heads the numbers fluctuate In addition to these students, 1047 members of the faculty staffs were engaged in chemical research. In the pamphlet giving the results of the census (*Reprint and Circular Series of the National Research Council*, No. 84. Washington, D C.· National Academy of Sciences, price 20 cents) figures are given separately under each sub-head for each university, together with the name of the head of the department of chemistry. In the same pamphlet are statistics showing the number and amounts of fellowships and other stipends received by graduate students in chemistry in 119 universities in the United States in 1927–28. Of the total number of such students, 45 per cent received no financial assistance either from the university or from outside organisations. More than one-third of these self-supporting students (418) belonged to Columbia University, New York.

Calendar of Patent Records.

June 9, 1683.—Great public interest was aroused by the patent granted on June 9, 1683, to Robert Fitzgerald and others for his process for obtaining fresh from salt water. A previous patent granted in 1675 to William Walcot for a similar invention was voided by the Privy Council on the ground that it had not been put into operation, and it is said that Fitzgerald's prescription, certified by Robert Boyle, was sent by Charles II. to the Lord Mayor "to be kept lest a secret of so great importance might come to be lost". But it was Fitzgerald's process that eventually proved a failure and Walcot's that triumphed. In 1695 an Act of Parliament was passed restoring Walcot's rights and granting him a 35 years' monopoly.

June 9, 1842.—The direct-acting steam hammer, first reduced to a practical form by James Nasmyth, was patented by him on June 9, 1842.

June 12, 1704.—The rise of the Irish linen trade is due very largely to Louis Crommelin, the leader of a small band of Huguenots settled in Belfast, who contracted with William III to supply the requisite machinery and material and to teach the Irish the art of linen manufacture in return for the interest on his expenditure and £300 a year. On June 12, 1704, the Signet Office in London records a patent granting to the Board of Trustees of the Linen Corporation and the Lieutenant Justices of Ireland a yearly sum of £1180 for ten years for the purpose of encouraging the manufacture, the payment of £200 a year to Crommelin "for his paines and care in carrying on the work", and £120 a year to three assistants, with a pension of £60 a year to a French clergyman for the Huguenot colony

June 12, 1806.—The purification of coal gas with lime was suggested in the early days of gas manufacture. Edward Heard, on June 12, 1806, patented a process in which the lime was charged with the coal in the retorts, but the proposal did not come into general use until it was reintroduced by W J Cooper in 1882.

June 13, 1551.—The first patent of which there is any record in France is that granted for ten years by Henry II to Theseo Mutio, an Italian, on June 13, 1551, for making all kinds of Venetian glass The manufacture was not successful, but the experiment paved the way for the subsequent encouragement of Italian workmen by Henry IV.

June 13, 1772.—William Tutin's is a noteworthy name in the history of the manufacture of shoe buckles, an important Birmingham industry in the eighteenth century Tutin was the inventor of the alloy—made of brass, antimony, and tin—called "Tutania", of which most of the buckles of the period were made, and on June 13, 1772, he was granted a patent for a process of japanning buckles "so as to equal and far exceed in cheapness and wear the common blue-coloured buckles, which are coloured by the heat of the fire, and are liable to be damaged by wet".

June 13, 1922.—Insulin, the pancreas extract used in the treatment of diabetes, was isolated by Dr. G F Banting and Dr. C H. Best, of the University of Toronto, and in order to safeguard the public interest the method of extraction was patented in Great Britain on June 13, 1922 The University of Toronto invited the Medical Research Council to assume the responsibility for its production in Great Britain and conveyed the patent rights to the Council as a free gift The word 'insulin' is due to Sir Edward Sharpey-Schafer, who coined it about 1911 in anticipation of the discovery.

Societies and Academies.

LONDON

Royal Society, May 30.—O. W. Richardson and P. M. Davidson: The energy functions of the H_2 molecules. The terms in the expansion of the force function are determined for certain states by various methods and show satisfactory agreement. Negative total energies, heats of dissociation and other constants of about thirty H_2 states are tabulated. Curves are drawn for the mean kinetic energy of the electrons of certain states at various nuclear separations. An appendix contains a theorem on the mean energy of a system of particles in any condition of periodic motion, when some of the particles are fixed.—E. K. Rideal, C. P. Snow, F. I. G. Rawlins, and A. M. Taylor: Infra-red investigations of molecular structure (1).—C. P. Snow, F. I. G. Rawlins, and E. K. Rideal: Infra-red investigations of molecular structure (2). The vibration-rotation band spectrum of nitric oxide proves to be a fundamental, with its centre at 1882.9 cm.$^{-1}$, with the fine-structure consisting of P, Q, and R branches with at least 42 rotation bands in each of the P and R branches. The molecular constants derived from the separation of the fine-structure bands (3·35 cm.$^{-1}$) corresponds almost exactly with those obtained from electronic band spectral data. The presence of a Q branch is in accordance with the gyroscopic character of an odd-electron molecule. The facts relating to the ground state of nitric oxide, its physical magnitudes, and its electronic angular momentum about the nuclear axis, form a consistent whole.—A. Muller: The connexion between the zigzag structure of the hydrocarbon chain and the alternations in the properties of odd and even numbered chain compounds. Starting from the fact that the CH_2-groups are arranged in a zigzag line, it is shown that there must exist an essential difference in the structure of the odd and even numbered substances. This difference accounts for the alternations of properties.—O. W. Richardson and F. S. Robertson: The emission of soft X-rays by different elements at higher voltages.—L. P. Davies: The soft X-ray emission from various elements after oxidation. The effect of oxidation on the total soft X-ray emission from the following elements has been studied: Silicon, manganese, iron, cobalt, nickel, copper, molybdenum, palladium, and tungsten. The efficiency of the oxide seems to be the average efficiency of the oxygen and element present.—D. L. Chapman and W. K. Hall: A study of the catalysis by silver of the union of hydrogen and oxygen. The new method of Hughes and Bevan was used and the conclusions confirmed by direct measurements of the falls of pressure which occur when the gases, separately and mixed together, are brought into contact with a large surface of silver. The mechanism of the action seems to be one of alternate reduction and re-oxidation of an oxide film. The fact that a film formed at low temperature is more effective than one formed at a higher temperature suggests that some of the molecules of silver oxide in the former are in relatively unstable positions, and therefore more active chemically.—R. H. Fowler and A. H. Wilson: A detailed study of the 'radio-active decay' of, and the penetration of α-particles into, a simplified one-dimensional nucleus. The authors solve exactly for a simplified nucleus the problem of α-particle disintegration (determination of the *complex* characteristics of the wave-equation with the proper boundary conditions), and discuss the converse problem of the penetration of an α-particle into the nucleus from without.—G. I. Finch and D. L. Hodge: Gaseous combustion in electric discharge (3). Combustion of dry detonating gas in the direct current discharge is primarily determined by the ionisation of both the constituent molecules of the gas. Electrostatic forces keep apart positively charged ions, unless such forces are counteracted by some other agency; one such agency is negatively charged metal atoms sputtered from the cathode which, by forming electrically neutral metal-gas complexes with positive ions, overcome electrostatic repulsion and thus enable combustion to proceed.—G. I. Finch and J. C. Stimson: The electrical condition of hot surfaces during the adsorption of gases (3). A hot platinum surface exhibits a charge when *in vacuo* or in contact with gases. With alternate treatment with oxygen and hydrogen at 500° C., it will exhibit a charge in hydrogen or *in vacuo* at room temperature. Heating at 850° destroys such superactivity. The charge due to any gas can be rapidly removed by evacuation at 850°. The destruction of the superactive condition is due to a structural change in the arrangement of the surface atoms akin to sintering.—J. M. Robertson: An X-ray investigation of the structure of naphthalene and anthracene. Using the rotating crystal photographic method, the general and statistical considerations of the reflections indicate a periodic structure parallel to the c axes of the crystals. Geometrical structure factors are developed and the dimensions of the molecules calculated differ only slightly from those of Bragg's tetrahedral structure. Thus the tetrahedral properties of the carbon atom are maintained in aromatic structures.—K. Majumdar: The arc spectrum of chlorine. The spectrum has been photographed in the region λ6400-8700. The ionisation potential is calculated as 13.1 volts.—K. R. Rao: The arc spectrum of germanium. Observations have been extended to λ1630 and about fifty new lines have been added, most of which have been classified. The ionisation potential of Ge I is 8.09 volts approximately.—U. Nakaya: On the emission of soft X-rays by different elements, with reference to the effect of adsorbed gas. The absorption of these rays increases with the amount of the adsorbed gas molecules on the photoelectric plate, while the excitation decreased with the presence of gas molecules. Reliable data were secured by bombarding the photoelectric plate and target to red heat in the highest vacuum and afterwards reducing the oxide films on these surfaces with hydrogen.—N. F. Mott: The scattering of fast electrons by atomic nuclei. The scattering of electrons by an atomic nucleus is investigated, using the wave equation of Dirac and a scattering formula obtained which gives the spin-relativity correction to be applied, for fast β-particles, to the usual Rutherford formula.—L. J. Freeman: Further investigations of the spectrum of ionised nitrogen (N II). Nine terms belonging to a quintet system have been identified and two new terms of the triplet system. Some 75 lines have been newly classified.—A. E. Gillam and R. A. Morton: The absorption spectra of halogens and inter-halogen compounds in solution in carbon tetrachloride.—R. A. Frazer and A. J. Duncan: On the criteria for the stability of small motions.—R. A. Frazer and W. J. Duncan: On the numerical solution of equations with complex roots.—G. C. McVitie: On Einstein's unified field theory.

Physical Society, May 10.—W. E. Sumpner: Heaviside's fractional differentiator. The paper deals with (1) Heaviside's experimental methods; (2) the index operator, its definition and justification; (3) its use with Leibnitz's theorem; (4) its use with binomial and exponential expansion; (5) functions of the operator; (6) Heaviside's operators; (7) examples; (8) the impulse function.—J. H. Awbery:

A simple method of fitting a straight line to a series of observations The method has a rational basis, and can be carried out much more quickly than the method of least squares —**E. W. H. Selwyn**: Arc spectra in the region λ1600–λ2100 A simple method is described of photographing ordinary arc spectra down to about λ1600 Additions have been made to the analysis of the spectra of Mg I, Bc I, and B I —**K. R. Rao**. The spectrum of trebly ionised thallium —**G. A. Wedgwood** The elastic properties of thick cylindrical shells under internal pressure. An experimental investigation of the usually accepted theory. Longitudinal and diametral extensions were determined of a number of steel cylinders subjected internally to hydrostatic pressure, the cylinders being closed at the ends by covers secured to the shell itself Discrepancies seem to be due to the non-isotropic nature of the material.

PARIS

Academy of Sciences, April 29.—**Henri Villat**: The alternating vortices of H Bénard in a canal of finite width —**E. Mathias**: Contribution to the study of fulminating matter Its two modes of decomposition A review of descriptions by witnesses of cases of globular lightning Certain of these describe the dissipation as without noise; in others, and these form the majority, the disappearance was accompanied with very violent explosions.—**J A. Schouten**: The geometrical signification of the semi-symmetrical property of an integral connexion, which leaves invariant the fundamental tensor.—**Georges Durand**: A manner of conceiving the theory of envelopes —**D. Pompeiu** Certain systems of linear equations and an integral property of functions of several variables. —**René Lagrange**. Certain functions associated with the functions of Legendre —**E. Hille** and **J Tamarkin**: A relation between the results of Minetti and Valiron. —**Alex. Véronnet**: There are three distinct dynamics, and three only, corresponding to the three spaces of Euclid, Riemann, and of Cartan —**Lucien Féraud**: Some applications of Pfaffian systems —**René Lucas** Remark on the equations of electromagnetism.—**Neronoff** The law of attraction —**R. Hocart**. The diamagnetism of some binary halogen compounds The dismagnetism of the ions is not strictly additive, and hence it is not possible to describe the diamagnetic properties of substances by means of a single coefficient The coefficients of solutions of hydrochloric acid, common salt, and potassium chloride are given, the accuracy being from 0 1 per cent to 0·3 per cent.—**G. Foex**: The diamagnetism of the crystal of azoxyanisol and the precession of Larmor.—**Jean Becquerel** and **W. J. de Haas**: The fundamental law of paramagnetic magnetisation of a crystal and the law of paramagnetic rotatory dispersion.—**J Gillies**: The trajectory *3d* in the ionised atoms P II, S II, S III, and Cl III Quadruplets of Cl. III.—**Charles Nordmann**: A new method for the reproduction of colours.—**Marinesco**. The structure of solutions of gelatine A study of the relations between the dielectric constant of gelatine solutions and their concentration.—**Nahmias** The evaluation of the α-radiation of the active deposit of actinium by the measurement of its β-radiation —**H. Herszfinkiel** and **H. Jedrzejowski**. The conditions of formation of groupings of radioactive atoms —**René Delaplace** and **G. Rebière**: The irradiation of ergosterol. the action of the ultra-violet rays of quartz and of the soft X-rays. Diagrams are given showing the changes in the ultra-violet spectrum of ergosterol produced by various times of exposure to ultra-violet light. Soft X-rays produce effects qualitatively similar —**Antoine Willemart**. The isomerisation of some acetylene carbinols into ethylene ketones. The transformation of alcohols of the type $R_1R_2C(OH)-C\equiv CR_3$ into the ketones $R_1R_2C=CH-CO-R_3$ either by alcoholic sulphuric acid or through the chlorides is a general reaction. Several examples are given —**Huan**: The action of ethylmagnesium bromide on the tetrethyldiamide of succinic acid —**L. Royer**: The possible asymmetry of the corrosion figures obtained by an active isotropic liquid. Results on the corrosion of calcite crystals are given which are in general agreement with the views of Hettich —**A Amstutz**: The crystallophyllian conglomerates of Mayombe, in the French Congo —**P L Violle** and **A. Giberton**. The antitoxic properties of calcium towards sparteine sulphate A guinea-pig survived indefinitely the injection of a mortal dose of sparteine sulphate when the latter was mixed with a solution of calcium chloride.—**Marc Bridel** Researches on the variation of colour in plants in the course of their drying The glucoside of *Lathræa clandestina* is aucuboside (aucubine).—**Charles Pontillon**: The pigmentation of *Sterigmatocystis nigra* cultivated on fatty media The yellow coloration sometimes observed in *Sterigmatocystis nigra* cultivated on fatty media is a consequence of the lack of homogeneity of the culture medium due to the mode of preparation of the mineralised gelose solution —**René Wurmser** and **Jean Geloso**: A glucose derivative, a constituent of the oxido-reduction equilibrium of the cells —**Mme. L Randoin** and **R. Lecoq** The primordial rôle of the alimentary equilibrium in the utilisation of lactose —**Edouard Chatton, André Lwoof, and Mme Marguerite Lwoff**. The infraciliatures and the genetic continuity of recessive ciliary systems.

Official Publications Received.

BRITISH

Memoirs of the Indian Meteorological Department Vol 25, Part 3 Data of Heavy Rainfall over Short Periods in India Pp 109-143 (Calcutta Government of India Central Publication Branch) 2 2 rupees, 4s

Supplement to the Journal of the Indian Mathematical Society, Vol 17. Report of the Sixth Conference of the Indian Mathematical Society held at Nagpur in December, 1928 Pp iii+24 (Madras)

Annual Report of the Zoological Society of Scotland for the Year ending 31st March 1929 Pp 63+8 plates (Edinburgh)

Indian Central Cotton Committee Technological Laboratory Bulletin No 19, Technological Series No 14 Further Tests on the Effect of Temperature and Humidity on Cotton Spinning By A James Turner Pp 17 (Bombay)

Quarterly Journal of the Royal Meteorological Society Vol 55, No. 230, April Pp 103 214 (London Edward Stanford, Ltd) *7s 6d*

Apia Observatory, Apia, Western Samoa Report for 1926 Pp 96. (Wellington, N Z W A G Skinner)

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1204 (Ae 365) Wind Tunnel Experiments on the Design of an Automatic Slot for R A F 34 Section By F B Bradfield and F W G Greener (T 2682) Pp 11+4 plates *9d* net No 1215 (Ae 374) The Accelerated Motion of a Cylindrical Body through a Fluid By H Glauert (T 2727) Pp 10 *9d* net (London H M Stationery Office)

The Physiological Society Session 1929-30 Rules, List of Members and Dates of Meetings Pp 32+viii (London University College)

Proceedings of the International Mathematical Congress held in Toronto, August 11-16, 1924 Edited by Prof J C Fields, with the collaboration of an Editorial Committee Vol 1 Report of the Congress, Lectures, Communications to Sections I and II Pp 935 Vol 2 Communications to Sections III, IV, V and VI Pp 1006 (Toronto: The University of Toronto Press)

FOREIGN

Mitteilungen der Naturforschenden Gesellschaft Bern aus dem Jahre 1928 Pp xliii+269+6 Tafeln (Bern Verlag Paul Haupt)

Ministry of Agriculture, Egypt Cotton Research Board Sixth Report, 1925-27 Pp v+104+29 plates (Cairo: Government Press) 15 P T

Ministry of Agriculture, Egypt Technical and Scientific Service (Botanical Section) Bulletin No 87 The Branching of Egyptian Cotton Plants By Dr J Templeton Pp 5+2 plates (Cairo Government Press) 3 P T

Scientific Papers of the Institute of Physical and Chemical Research No 188 The Uranium-Thorium-Ratio in Monazites By Satoyasu Iimori Pp 229 236 20 sen Supplement, Vol 10, No 9 Geographical Distribution of certain Minerals in Japan By Satoyasu Iimori and Toyofumi Yoshimura Pp 5-46 45 sen (Tokyo Iwanami Shoten)

Journal of the Faculty of Science, Imperial University of Tokyo Section 2 Geology, Mineralogy, Geography, Seismology Vol 2, Part 8. Neogene Shells from some Provinces of Chūgoku By Matajiro Yokoyama Pp 363-368+1 plate (Tokyo Maruzen Co, Ltd) 45 sen

Department of the Interior Bureau of Education Bulletin, 1928, No 25 Biennial Survey of Education, 1924-1926 Pp iii+1204 (Washington, D C Government Printing Office) 2 30 dollars

CATALOGUES

Catalogue No 114 Zoologia Pp 60 (Paris Paul Lechevalier)

North America a Catalogue of Books, Pamphlets and Engravings (New Series, No 2) Pp 136+4 plates (London Francis Edwards, Ltd)

Diary of Societies.

FRIDAY, JUNE 7

ROYAL SOCIETY OF MEDICINE (Laryngology Section) (Summer Meeting), at 10 A M —F J Cleminson, M Woodman, and W S T Neville Treatment of Carcinoma of the Œsophagus —H Barwell and Dr J A Gibb · Inflammation in the Maxillary Antrum and Frontal Sinus — At 5 —Dr W J Horne Cancer of the Vocal Cords

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Scottish District) (at Town Hall, Hamilton), at 10 30 A M —W H Purdie Hamilton, Historical and Municipal —J Robertson Recent Road and Bridge Improvements in Lanarkshire —P A Leitch Notes on a Costing System —T M Stephen A 'Removal'

GENETICAL SOCIETY (at Linnean Society) (Annual General Meeting), at 3 —Prof D E Lancefield The Genetics of *Drosophila obscura* —Dr C Stern Some Recent Work on *Drosophila*

PHILOLOGICAL SOCIETY (at University College), at 5 30 —Dr C T Onions The Supplement

GEOLOGISTS' ASSOCIATION (at University College), at 7 30 —Dr A K Wells, Dr A Brammall, and others Discussion on The Value of Petrographic Character as a Criterion of Age

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —C Leonard Woolley Excavations at Ur, 1928-29

SATURDAY, JUNE 8

NORTH - EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS —Unveiling at Wylam, at 2 30, of the George Stephenson Memorial Tablet, by the Lord Mayor of Newcastle-upon-Tyne

MINING INSTITUTE OF SCOTLAND (at Y M C A Institute, Ayr), at 4 — S Mavor Recent Progress in Underground Conveying

MONDAY, JUNE 10

PHYSICAL SOCIETY (at Imperial College of Science), at 5 —W E Pretty Pressure Shifts in Line Spectra of Gases —A S M Symons and J Daley The Zeeman Effect for the Arc Spectrum of Gold —Dr W Jevons The Band Spectrum of Lanthanum Monoxide

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8 30 —L T Scott The Saura Oases and the Niger from Timbuktu to Jebba

TUESDAY, JUNE 11

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5 —Dr H H Dale Some Chemical Factors in the Control of the Circulation (Croonian Lectures) (III)

MINERALOGICAL SOCIETY, at 5 30 —Dr G T Prior The Meteoric Stone of Lake Brown, Western Australia —E J Wayland Bismutotantalite, a New Mineral from Uganda —Dr L Hawkes On a Partially Fused Quartz-felspar-rock and on Glomero-granular Texture —Dr F Marshall The Occurrence of a Mineral Hitherto Unrecognised in the Phonolites of Dunedin, New Zealand —Fuloppite, a New Hungarian Mineral of the Plagionite semseyite Group Exhibited by Dr L J Spencer on behalf of I de Finaly and Dr Sandor Koch

ZOOLOGICAL SOCIETY OF LONDON, at 5 30 —C Coles A Talk on Australian Birds, illustrated with slides by Members of the New South Wales Royal Zoological Gardens —A E Ruxton and E Schwarz On Hybrid Hartebeests —E Schwarz On the Local Races and Distribution of the Black and-White Colobus Monkeys —Sir Arthur Smith Woodward The Upper Jurassic Ganoid Fish *Heterostrophus* —Miss E M Brown Notes on Hydrogen Ion Concentration, Excess Base, and Carbon Dioxide Pressure in Aquarium Waters —J W Low Contributions to the Development of the Pelvic Girdle IV The Pelvic Girdle and its Related Muscles in the Batrachian *Amphiuma means* Gardner

QUEKETT MICROSCOPICAL CLUB, at 7 30 —C H Oakden Various Forms of Photomicrographical Apparatus

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8 30 —Miss J Gaultier de la Verindry Folk Songs of Canada, Eskimo, Indian and French-Canadian

WEDNESDAY, JUNE 12

ROYAL SOCIETY OF MEDICINE (Surgery Section) (at Sheffield), at 2 and 6

ROYAL METEOROLOGICAL SOCIETY (Summer Meeting) (at Rothamsted Experimental Station, Harpenden), at 2 15

RESEARCH DEFENCE SOCIETY (at 11 Chandos Street, W), at 3 —Prof A V Hill Enemies of Knowledge (Stephen Paget Memorial Lecture)

GEOLOGICAL SOCIETY OF LONDON, at 5 30 —Dr E Mackenzie Taylor Base Exchange and its Bearing on the Formation of Coal and Petroleum

EUGENICS SOCIETY (at Linnean Society), at 8 —W T J Gun, Dr B Dunlop, and others Does Industry need Dullards?

THURSDAY, JUNE 13.

ROYAL SOCIETY, at 4 30 —F M L Sheffield Chromosome Linkage in *Œnothera*, with Special Reference to Some F_1 Hybrids —Grace Briscoe and Winifred Leyshon Reciprocal Contraction of Antagonistic Muscles in Peripheral Preparations—using Flashing Neon Lamp Circuit for Excitation of Nerve —W S Stiles The Scattering Theory of the Effect of Glare on the Brightness Difference Threshold — T Moran Critical Temperature of Freezing—Living Muscle —E C Smith · The Formation of Lactic Acid in Muscles in the Frozen State

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5 — Dr T J I'a Bromwich The Application of Operational Methods to some Electrical Problems in Diffusion —E T Copson and W L Ferrar Notes on the Structure of Sequences (II) —A T Price Electromagnetic Induction in a Conducting Sphere —C T Preece Theorems stated by Ramanujan (X) —Prof G N Watson Theorems stated by Ramanujan (XI)

INSTITUTE OF PATHOLOGY AND RESEARCH (St Mary's Hospital), at 5 — Prof J A Gunn Variations in Susceptibility to Drugs and Toxins

OPTICAL SOCIETY (at Imperial College of Science), at 6 30 —Experiments, Demonstrations, and Exhibits, arranged by the Technical Optics Department of the Imperial College —Exhibits of New Theodolites by Cooke, Troughton and Simms, Ltd , and E R Watts and Son, Ltd — At 7 30 —Dr W M Hampton The Beam given by Dioptric Apparatus

INSTITUTION OF ELECTRICAL ENGINEERS —Summer Meeting in France (June 12-22)

FRIDAY, JUNE 14

ROYAL ASTRONOMICAL SOCIETY, at 5 —T P Bhaskaran The Number of Stars of Different Magnitude in the Hyderabad Astrographic Catalogue Fifth Paper Zone −21° —Prof E W Brown The Planetary Theory with the True Longitude as Independent Variable

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Annual General Meeting), at 5 —E Maddox Demonstration of the Cheiroscope —Miss M Dobson Velanoskiascopy, a Control in the Correction of Astigmatic Defects

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6

SATURDAY, JUNE 15

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle upon-Tyne), at 2 30.

PUBLIC LECTURES.

FRIDAY, JUNE 7

KING'S COLLEGE at 5 30 —Prof H Wildon Carr The Philosophy of Leibniz (Succeeding Lectures on June 10, 12, 14, 17, and 19)

CONFERENCES.

JUNE 5 TO 8

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (at Brighton)

Friday, June 7, at 11 A M —H Dewey The Denudation of the Weald — Dr G P Bidder Death (Address)

At 12 —E A Martin The Brighton Rubble Drift, and Cliff Formation —A Griffith Some Sussex Birds and Insects

At 8 —Reginald A Smith Early British Art (Public Lecture)

Saturday, June 8, at 10 30 A M —Prof H J Fleure Regional Survey Address

At 11 30 A M —D Edwards Town and Regional Planning

JUNE 11 TO 22

INSTITUTION OF ELECTRICAL ENGINEERS —Summer Meeting in France

JUNE 13 AND 14

INTERNATIONAL CONFERENCE ON LARGE HIGH-TENSION SUPPLY SYSTEMS (at 9 Avenue Hoche, Paris)

Thursday, June 13—*In Morning* —Federal Railways (Switzerland) Recent Investigations and Tests on 132,000-volt lines —M Barrere Results Obtained in the Operation of a 120,000-volt System —P V Hunter and J F Watson Certain Aspects of the High-tension Distribution Problem —S Fukunaka and Taizo Ueno The Snow Trouble on a 154,000-volt Transmission Line, and its Remedy —F Courtoy Organisation of Electricity Generation in Belgium —G R Falkiner-Nuttal Load-dispatching in Large Electric Power Systems in the United States

In Afternoon —A Roncaldier Parallel Operation —A Smouroff Operation of Very Large Interconnected Supply Systems —U Del Buono Earthing the Neutral —L Maggi Experience with an Earthed Neutral on the 130-kv Systems of the Cisalpina Company

Friday, June 14—*In Morning* —C. I Budeanu Power Factor Improvement —F Rutgers Simplified Graphical Representation of Active and Reactive Power in Vectorial Diagrams —L Gratzmuller The Conservation of Reactive Power in Electric Systems —A Iliovici Measurement of Electrical Energy and Power at Very High Voltages —G Renesson Notes on the Measurement of Electrical Energy at High Voltages —A Barbagelata Metering and Tariffs in Three-phase Supply

In Afternoon —L C Grant Lightning and Surges on High-tension Transmission Lines —R O Kapp The Selective Protection of Transmission Lines —P Traverse Investigation and Statistics on Surges in Transmission Systems —F W Peek Developments in the Control of Lightning —Barbillion and Teszner The Rôle of Condensers and Similar Devices in the Protection of Networks Against Surges Theoretical and Experimental Study —K Gotoh and Matsunaga Lightning and 154,000-volt Transmission Lines —A Iliovici Selective Protection of Networks, Based on Unbalanced Currents, Voltages, and Power —A Tchernycheff A New Method of Protection for Heavy-current Equipment —M Walty Long-distance Communication in Electric Systems —A Tchernycheff Special Apparatus for the Protection of Long-distance Communication Lines —German Telephone Administration Measurement of the Coefficient of Mutual Induction between Two Lines with an Earth Return —T N Schulz Standardisation of International Statistics in Regard to the Generation and Distribution of Electric Power —P Rieunier Interconnexion of Systems Operating at Different Frequencies —J Kopeliowitch The Use of an Ohmmeter as a Selective Relay —L Gratzmuller Increasing the Number of Phases for a Supply to Mercury Converters, with a View to Reducing the Effect of Harmonics in a Distribution System

NATURE

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Science in the Public Service and Industry.

WE commented last week upon the appointment of a committee to inquire into matters affecting the functions and staffs of certain research and experimental establishments of departments of Government This inquiry is, of course, separate from that of the Royal Commission on the Civil Service which Mr Baldwin recently announced would be appointed We trust that the change of Government will not mean that this Commission will be dropped. A really wider issue than that of the position and functions of the technical expert in the Civil Service is involved , indeed, the time is ripe for an inquiry into matters affecting the position and responsibilities of the man of science and the technologist generally, in industry as well as in the public services

For some considerable time a suspicion has existed that matters affecting the status and responsibilities of the technical expert are very far from satisfactory in Great Britain. As regards the public services, it is possible nowadays, more or less, to gauge the situation, owing to the existence of the many specialised vocational associations which have, in recent times, been formed within the Civil Service and the Local Government Service for the purpose of protecting the interests of their members , practically all these associations periodically issue publications dealing with their activities, and thereby give an insight into the nature of the problems to which attention has been devoted Furthermore, the Royal Commission on Local Government appointed on Feb. 14, 1923, under the chairmanship of Lord Onslow, has during the past twelve months taken evidence from some of these vocational associations, particularly in relation to the duties and status of the technical offices under the local authorities ; in this evidence the practice of the central government has been touched upon, and its attitude towards its technical officers has been contrasted with that of the local authorities towards their chief officers who are engaged mainly on technical duties

In industry, no institutions with objects identical with those of the vocational associations referred to above exist , consequently, it is more difficult to obtain generalised information regarding the status and responsibilities of those engaged on the technical side of industrial and commercial undertakings In view of the great national importance of the subject, individual inquiries have been addressed in relation thereto to a number of persons engaged on technical duties in some of our

industries As might be expected, the information collected shows that in industry the conditions vary very widely, and also that the attitude of the chief officials responsible for the conduct of the affairs of various important concerns differs to some extent in relation to the status and responsibilities which should be assigned to the section of the staff which deals with the technical work In some cases the chief officials are unresponsive to the changing conditions of the times (needless to say, to the detriment of the businesses they control), whilst on the other hand, happily, many such officials are broad-minded, progressive, and ever ready to meet the altered, and altering, conditions imposed by the more intense trade competition arising from the more exacting requirements due to increased scientific knowledge and to the high technical skill and ability of the staffs of their foreign competitors.

Our inquiry into this subject has disclosed the fact that in industry old prejudices are gradually dying, and that, in recent times, a considerable improvement has taken place in the status of the men of science and the technologists who follow their careers in the commercial world There is still room, of course, for further improvement, which will no doubt come about in time, the matter seems to depend upon two factors, namely, on the introduction in our industrial enterprises of an organisation adapted to meet the very complex technical requirements of to-day, and on the willingness of the technical expert fully to qualify himself for the more important administrative posts by devoting his time not only to the study of subjects of a strictly scientific and technical kind, but also of those bearing on the administrative and economic aspects of his work

The improvement in the status of the man of science and technologist to which attention has been directed is due, it has been suggested, to the rise and growth of the electrical industry It has been pointed out that many of the successful businesses connected with this industry have been founded, developed, and managed by men who have had the advantage of a scientific education and of a technical training; many of the most important posts are still held by a type of man with similar qualifications Being an entire newcomer, and probably also by reason of the fact that much technical knowledge was involved in almost every decision, this industry was not hampered at its birth by some of the harmful traditions that have tended to limit the sphere of usefulness of the technician in the same way as has been, and still is to some extent, the case in some of the older ones. The new policy has very greatly benefited the electrical industry and has enabled it to reach a flourishing condition

Now, a very cursory examination of the information contained in books of reference indicates that the improvement in the status of the technician is not confined to the electrical industry; almost simultaneously with its birth an infection seems to have spread to other industries It is on record that in 1883, when the late Sir William (afterwards Lord) Armstrong first founded his famous Tyneside shipbuilding works, he entrusted the organisation and the directing of this establishment to a technician, who some years later became Director of Naval Construction and Assistant Controller of the Royal Navy At subsequent dates, some of our railway companies selected officers from the technical side of their undertakings for high administrative posts Again, the chemical industry affords instances of chemists who have risen to the control of huge interests and have done well as administrators. Men with technical knowledge and experience are also now occasionally appointed as directors on the boards of companies, this is so not only in the cases alone of those concerned with activities of an industrial kind, but it also applies equally to those whose interests are mainly financial or commercial.

Apart from the government services and industry, there are the great municipal services The Royal Commission on Local Government now sitting has received a considerable volume of evidence on the aims and objects of the various vocational associations by witnesses representing them, and questions have also been raised by other witnesses as to the desirability, or otherwise, of arranging for interchanges of duties on the part of civil servants and local government officers by temporary transfers of staff from government departments, particularly the Ministry of Health, to the offices of local authorities, and vice versa Moreover, a proposal involving a fundamental change in the constitutional fabric of municipal government has also been put forward, namely, one relating to the appointment in our municipalities of a 'chief officer' corresponding to the burgomaster, who is supreme in relation to municipal affairs in certain continental cities, or of a person possessing the authority and the responsibilities of the city manager who is now in charge of municipal affairs in many important American cities Neither proposal, however, is given much support by local government officers.

The town clerk, who is generally a member of one of the legal professions, is, by an almost immemorial custom, recognised as the principal officer of the Local Authority; he is *primus inter pares*, and, apart from the particular duties of his own department, co-ordinates the various services of the council, in order to avoid overlapping and to prevent a course being taken by one department without consideration for its effect on another department. It is, however, recognised that it would be most improper for a town clerk to criticise or interfere with a technical officer in the carrying out of the technical duties assigned to him, that is to say, the technical officers under a local authority severally exercise their functions independently of the town clerk The practice of local authorities differs, therefore, very widely from that of government departments, in the latter case, the technical branches are elaborately controlled by the secretary's department

Some of the members of the Royal Commission appear to have been exercised in their minds with regard to the difference of treatment meted out to the two types of officers, the administrative and the technical, in the national civil service and in the local government service; in consequence, questions were put to some of the witnesses with the view of eliciting the reasons why in the latter service it is those with technical qualifications who hold the positions of 'chief officers', and it is considered that there is no field in it for the person without technical qualifications—the 'skilled administrator'—although in the case of the Civil Service the former type of official "did not get to the top of it", whereas the latter type did so invariably.

It has been pointed out that the difference in the treatment of the two types of officers in the two services may be accounted for historically, whereas the first services entrusted to a municipal corporation were of a character which required technicians at the head of them, on the other hand, the responsibilities of government departments originally involved the consideration of problems in which the administrative aspect predominated. It is further suggested that county and municipal councillors themselves do the administrative work, and rely directly on their officials for technical advice A century ago, ministers of the Crown were able to do, and personally did, a great deal of the administrative work of their departments, but, with the increasing complexity of the problems to be dealt with, the methods then in vogue went out of date and had eventually to be abandoned The system which was introduced later for dealing with the work of government departments has, in its turn, become obsolete.

In the evidence given before the Commission, strong adverse criticisms have been made regarding the narrow rules of the Civil Service, which, as a matter of practice, prevent an officer on the technical side, however well fitted and qualified he may be for the position, being promoted to the higher administrative posts In view of the fact that administrative ability of the first rank is so rare, the policy which prevails in the Civil Service in relation to this matter has been characterised as being inexpedient, short-sighted, and unjust.

It is essential that ministers of the Crown should frankly recognise that government departments have completely outgrown the organisation with which they are now endowed, and even that their own positions therein, and the functions they are attempting to exercise, which are very similar to those of a general manager, no longer conform with the requirements of the day

Alterations of a far-reaching character are, in consequence, needed in the organisations of our government departments. One of the principal features of the reconstruction of such departments should be such as to provide that the functions assigned to ministers in charge of government departments shall correspond with those of a chairman of a board of directors, or of a commission, and that they shall be aided directly by a body of highly qualified technical experts occupying positions somewhat similar to those of the directors of a company, and be given a distinctive title, for example, they might appropriately be called 'commissioners'. If such a reform was carried out in a whole-hearted manner, ministers would be placed in a better position than at present to obtain the technical advice required in connexion with the formulation of their policies, since it would reach them at first-hand. If, further, each of these 'commissioners' was also charged with responsibility for both the administration and the technical work of the various specialised branches of a government department, immediately under the direction of the responsible minister, the management of the public services under the central government would be more efficient and economical than is the case to-day; and the ministers themselves would also be placed in a position to exercise their proper functions more effectively, and, consequently, their usefulness and the value of their work to the State would be enormously increased.

Shellfish Pollution.

Ministry of Agriculture and Fisheries. Fishery Investigations, Series 2, Vol. 10, No. 1, 1928 *Report on Mussel Purification; being an Account of the Establishment of a System of Purification of Polluted Mussels, of the Experimental Work upon which it is based; and of certain General Considerations and Suggestions regarding the Sewage Pollution of Shellfish in its Public Health Aspect* By Dr. R W Dodgson. Pp xvi + 498 + 16 plates. (London His Majesty's Stationery Office, 1928.) 21*s* net

THIS encyclopædic summary and critical analysis of our knowledge of shellfish pollution will long remain the standard work of reference on a difficult problem hitherto baffling even the experts It is thus an essential addition to every up-to-date public health library But to public health authorities it is also a conspicuous milestone of progress, in that it records how scientific research, by evolving a method proved reliable through a dozen years of extensive practical trial, has solved the problem of purifying sewage-polluted shellfish Seldom, indeed, does an official report on practically applied science reveal so many and so varied abilities as this: its erudition, lucid presentation and scientific interpretation of facts, shrewd judgment, and sound business sense—all are so freely interspersed by touches of 'pawky' humour as to make its perusal a keen pleasure.

Initially, Dr Dodgson reviews fully the literature on the existence and classification of human diseases attributed to eating shellfish. 'Mussel poisoning', which is very fully discussed, is classified into three categories: the erythematous, the paralytic, and the bacterial food-poisoning type The characteristics of the first two, and the points to which attention is to be directed in making a differential diagnosis, are clearly set forth There should in future be no excuse for the confusion which has hitherto existed in some quarters in connexion with these conditions Dr. Dodgson's analysis of the evidence establishes two points of much importance to the consumer, namely, that the erythematous type ('musselling') is never fatal, whilst the danger of contracting the fatal paralytic type is, if elementary precautions and common sense are exercised, for practical purposes negligible.

The author then considers the correlation of shellfish pollution and certain human infections. His initial six months' study of the physiology of the mussel was rewarded by the discovery of the cardinal fact that it filters from the water passing through it all suspended solids—including infective germs discharged by sewers into estuaries, which are most grossly polluted at low tide when shellfish are gathered Following up the trail of infection, he found untreated sewage entering estuaries from many forgotten sewers, the pollution from which was, in some cases, particularly pernicious, for example, that from isolation fever hospitals In one instance excreta from an enteric patient were discharged from a sewer mouth within 50 yards of a mussel-bed on to which they flowed so rapidly that germs might enter the mussels within three minutes of being voided by the patient! This fully evidences the risk of human infection by the 150,000 cwt of mussels eaten annually, mostly uncooked, in Great Britain, particularly when, as Dr Dodgson indicates, the fresher the fish the greater is the risk of its retaining and passing on infection.

The general position is summed up as follows (p. 119):

"As long as dirty food—*polluted* shellfish—is used for human consumption, a serious gap must exist in the defences erected by public health effort against typhoid and other serious disease This gap is not only serious, but is one of the most pernicious of all possible gaps, for it means that we are permitting the infective material from typhoid fever patients and typhoid carriers, and that responsible for other grave diseases, to be poured on to a living article of food, so constituted as to be capable of collecting and concentrating within itself such infective material from an enormous volume of water, and, having permitted this to happen, we allow the concentrated infection to be distributed all over the country, just when we had hoped and believed that we had safely got rid of it, once and for all"

A review of remedies previously proposed shows the impossibility of keeping all sewage from all edible shellfish, and the impracticability of sterilising polluted shellfish by heat or by chemicals While urging that sewage from hospitals housing such cases as enteric should be compulsorily sterilised, chemically or otherwise, prior to discharge into any watercourse, the author shows that this method cannot be reliably or economically applied to the host of other sewers now discharging into our estuaries. This section concludes with an able and comprehensive review of existing legal powers, which are shown to confer upon local authorities means of enforcing the simple and effective method of shellfish purification described below.

The practical outcome of apparently abstract

research is aptly illustrated. To aid in studying the course of water-currents within the mussel, Dr Dodgson coloured water with fine carmine powder, and thus discovered that, as the water circulated within them, the mussels filtered off all the carmine, and extruded it firmly entangled in mucoid threads (fæces and pseudo-fæces) which resisted disintegration for more than a month in still water. Experiments proved that bacteria were similarly filtered off, and that even heavily polluted mussels rapidly freed themselves from polluting germs in water of suitable salinity and at ordinary temperatures. Even at freezing-point or thereabouts similar results were obtained during the night or in artificially produced darkness. In running sterile water three hours might suffice for the elimination of all bacteria

This remarkable result is largely achieved by the mussel's gills, which consist of a network of fine ciliated filaments The ciliary currents cause the water to circulate between the filaments suspended matter, including bacteria, being filtered off and becoming entangled in sticky mucus, finally to be extruded from the shell either via the gut (as fæces) or directly via the marginal recurrent ciliary stream (as pseudo-fæces) As a single large mussel may thus pass through its body in 24 hours as much as 14 gallons of water, this purifying process is obviously a most powerful factor, and its cleansing action is not aided by the use of water containing active chlorine, because any disinfectant strength of chlorine inhibits or actually arrests the physiological activities of the mussel—thus leading to the retention of bacteria in the mussel-body, which would otherwise have extruded them

The practical outcomes of these researches have proved of the utmost value, alike to consumers and purveyors of shellfish and to public health authorities. That value lies in the discovery and proof of the fact that there is available a trustworthy, cheap, and simple process, whereby shellfish—although gathered from polluted estuaries—may be rendered as nearly safe for human consumption as any reasonable authority can require The stages of that process, as regards mussels, for example, are as follows :

(*a*) Sea-water, pumped into a tank, is sterilised from all germs by adding to it 3 parts per million of active chlorine derived from bleaching powder.

(*b*) Any residue of active chlorine remaining after a night's exposure in the tanks having been removed by hyposulphite, the water is then run into other tanks containing mussels spread two-deep upon wooden grids (the mussels having initially been hosed with high-pressure fresh water to remove adherent mud). In this sterile, unirritating water, the mussels function perfectly, and eject practically all infective germs from their bodies during the ensuing night.

(*c*) The water is then run off, and the ejected mucoid fæces and pseudo-fæces are hosed away. As an extra precaution, stages (*b*) and (*c*) above are repeated

(*d*) Any germs on the outsides of the shells are removed by exposing the mussels to a bath of water containing active chlorine in solution (3 parts per million).

(*e*) The mussels are loaded into sterilised sacks, which are sealed before dispatch to market with lead seals stamped 'M A.F. Conway', and bearing the date of dispatch.

As thus carried out, this process is so effective that mussels so polluted as to contain 600 sewage germs per cubic centimetre (about a salt-spoonful) of their substance, are so purified that this number is reduced in many instances to none , in most cases to less than three ; and in almost all to less than five. In comparison with the gross bacterial pollution of various articles of food which are consumed uncooked, such a degree of freedom from germs is truly remarkable, as initiating a new standard of cleanliness for foods.

From the business aspect no objections are forthcoming, for the process may be deemed capable of paying for itself on the basis of an output of 8000 bags per annum, and a charge of 1*s*. 6*d*. per bag of 140 lb. of mussels purified ; the capital expenditure varying from £3000 to £4500 according to site chosen. From the administrative point of view, the working and control have been proved, by some years of trial, capable of being carried out with smooth effectiveness by an adequately trained tank superintendent and one unskilled assistant.

This valuable report thus introduces a notable contribution to our means for preservation of the public health, and, as such, will be welcomed by all upon whom that responsible duty falls That, however, is by no means all the story, for, as Dr. E S. Russell, the Director of Fishery Investigations, observes in his preface : "It is significant that the real key to the problem was found in direct and minute observation of the normal physiology of the mussel." Not only has a solution of a difficult practical problem been found by scientific research, but that research has also added a most interesting chapter to our knowledge of molluscan physiology.

Perhaps a still more important contribution to

science has been rendered by Dr. Dodgson in this comprehensive report by his skilful and courageous criticism (in Part 3) of bacteriological principles and methods of some antiquity and much in need of the caustic consideration which they receive. Here again, research and the original discovery that glucose is formed from the tissue-glycogen of shellfish pointed the way to criticism of certain bacterioscopic methods depending on the fermentation of lactose, which, though based on perfectly sound general principles, may be quite misleading when applied to the particular case of shellfish analysis. But the "cogent evidence" to which Dr. Russell refers in respect of this phenomenon and of the errors likely to be introduced by the element of chance in the interpretation of results is as resistant to concentration in a review as it is important from the point of view of the experts. It will require an extensive reply from the strictly orthodox.

Babylonian Astronomy and Chronology.

The Venus Tablets of Ammizaduga: a Solution of Babylonian Chronology by Means of the Venus Observations of the First Dynasty By Prof. S. Langdon and Dr. J. K. Fotheringham. With Tables for Computation by Carl Schoch. Pp. vi + 109 + xvi. (London Oxford University Press, 1928.) 35*s*. net.

THIS is a work of great interest to students both of archæology and of astronomy. The story of the many stages that were necessary before a full understanding was reached of the astronomical value of the tablets is as fascinating as a romance The tablets that have come down to us were copies made in the eighth or seventh centuries B.C. of originals more than a thousand years earlier. We are fortunate in possessing a number of different copies of the originals; the calendar dates recorded in duplicate copies are not in perfect agreement; it is a familiar fact both in ancient and modern times that numbers are particularly liable to erroneous transcription. We can reasonably ascribe the few discordances that remain in the solution to this cause.

The tablets are in the form of omens, stating that such and such configurations of Venus (Ninsi-anna is the name used) on given calendar dates will be followed by such and such events on earth. *A priori*, such documents would seem void of astronomical value, but convincing reasons have been found for believing that the omens were based on experience, and that such configurations and subsequent events had actually occurred. The date of the originals was not even roughly known until Father Kugler announced in 1912 his discovery that a Sumerian phrase that had hitherto been misunderstood meant "The year of the golden throne", and was the date formula of the eighth year of Ammizaduga, commemorating his placing a golden throne and a statue of himself in a Babylonian temple. This fixed the date within two centuries or thereabouts, and it was now possible to calculate the positions of Venus for different possible years The fact that transits of Venus usually occur in pairs, separated by 8 years less $2\frac{1}{2}$ days, is well known. Any configuration of Venus with respect to the earth recurs after a similar interval of time. But when a lunar calendar is used, the recession of the date after 8 years is 4 days, so this calendar is more sensitive than the solar one to a change of date. However, an interval of 56 years would bring back the event to the same day of the month, but this would be the month preceding the original one. Since the beginning of the year was somewhat elastic in those times, this might bear the same name as the original month, the same thing might even happen after a second period of 56 years; if the dates were given somewhat roughly, or the days of the month wrongly copied, there might be further uncertainty of one or two multiples of 8 years. Thus we find that Kugler first adopted the year 1977 B C as the first of Ammizaduga's reign, but later he made it 176 years later in consequence of some arguments of Weidner.

Dr Fotheringham then took the matter up at Prof. Langdon's request He improved Kugler's calculation in two ways. first, by taking into account the accelerations of the sun and Venus which had been found from discussion of ancient eclipses and in other ways; secondly, by noting that the duration of the invisibility of Venus at conjunction with the sun depends on its latitude, which in turn depends on the date in the solar year. He reached the date 1921 B.C. as the first year of Ammizaduga; it is a curious coincidence that the A D. date of its first publication was only two years different (1923).

The date 1921 B C. is retained in the present publication, and the arguments in its favour have been considerably strengthened. With the view of locating the months of the lunar calendar in the solar year, a number of contracts relating to the harvests of corn and of dates have been discussed. Kugler made a beginning in this research, but it has been extended. Also Herr Schoch devised a

new method, based on the lunar months which were recorded as having had 30 days , this method would not be in itself decisive, but it gives some clue to the actual dates of new moon ; it is found to support the above solution. Another confirmation is found in the accord between the chronology based on this date and that based on Schoch's identification of the lunar eclipse that preceded the fall of Ur with the one that occurred on Mar. 8/9 (Julian) in 2283 B C. The record of that eclipse, like the Venus tablets, is in the form of an omen

The book contains a complete chronological list of the kings of Sumer and Accad, Babylonia and Assyria ; it combines the deductions from the Weld-Blundell prism with those of the present volume. It is well to direct attention to the note on p. 83 that all the dates of the table before 2300 B C. should be made 19 years later, since these had been set up before Schoch's date for the fall of Ur had been adopted. Sargon of Agade reigned from 2732 to 2677, and Narâm-Sin from 2652 to 2615. Thus Nabu-na'id, the last king of Babylon, made an error of some 1100 years in saying that Narâm-Sin preceded him by 3200 years.

The book also contains discussions on the occurrence of intercalary years, both in Ammizaduga's and neighbouring reigns ; these seem to have depended largely on the whim of the monarch. There are tables, prepared by C. Schoch, for finding approximate positions of the planets, and for obtaining the date of new moon at any epoch between 3500 B C. and A D 2000.

The full text of the tablets is also given, both in cuneiform and transliterated, with translation and comments by Prof. Langdon.

A. C. D. CROMMELIN

World History since the War.

1918–1928 : a Short History of the World. By C. Delisle Burns. Pp. 447. (London : Victor Gollancz, Ltd., 1928) 16*s* net.

FOR those who desire a compact and trustworthy survey of world history since the War from the political point of view, there is nothing to be had to compare with this book. It relies mainly on the much fuller accounts given in the several volumes issued by the Royal Institute of International Affairs, and it adds to them where they have not yet dealt with the particular problem. The view suggested is, on the whole, hopeful, and would be more so but for the one serious defect to be mentioned later. It points out, for example, the improved stability of Germany since the War. The German Reich is now much more powerful as against any of the local patriotisms of Germany than it was before the war "; and again, " whereas the unity of the Russian people was dissolved by the war, that of the German people was confirmed". The real reason for this difference, however, is not hinted at, and it will be found in the defect to be referred to below

There is a wholesome protest, often repeated, against disparaging the increased attention given since the War to the economic aspect of politics.

The increase of wealth and decrease of the incidental burden in producing it, is not in the least ' materialistic '. The life of the body is the life of the spirit There are not two lives in the common man." The ' common ' man, by the way, occurs with rather tiresome iteration and provokes the inquiry who he really is. " The neglect of food supply and its incidentals—finance and commerce—by rhetorical politicians and diplomatists is not a sign of their superiority, but of their blindness to the importance of these basic factors on which their own comparative freedom from economic insecurity rests " So far, of course, as these persons do these things, they are open to Mr. Delisle Burns's censure. But surely they are doing it very little now ?

These signs of a somewhat jaundiced eye are trifling and rather interesting blemishes on an excellent piece of work But a word must be said on the really serious point. How can anyone, above all anyone of Mr. Delisle Burns's knowledge and breadth of mind, offer us " A Short History of the World " without a word on the enormous development and influence of science, and that at a time when its development and influence have been greatest ? It is not, as might be urged, a question of limiting the field, for other matters, desirable for a complete view, may be left out without essential damage to the main argument. One can write a history of the last ten years without mentioning the poetry and art of the period. It would be incomplete, but not vitally mutilated. One cannot do so without science, because science is at the base of that shrinkage of the world and that permanent establishment of international relations of which Mr Delisle Burns is as conscious and as firm a defender as anyone. To take two crucial examples from the book itself. It is because Germany was a scientifically organised and educated country that she survived the War as she did and has increased her coherence, and because Russia was not that she went down ; and, on the largest issue which arises in the period, it is because the nations of the West are the guardians of this

scientifically organised society that they must maintain their position *vis-à-vis* of the East and the less developed peoples of the globe.

It is almost unnecessary to add that these last ten years have also witnessed the most amazing extensions of the scientific spirit, above all in astronomy and physics, that humanity has ever gained These belong to all mankind, they afford the easiest means of binding the nations together, and they lift the mind above the atmosphere of jealousy and discord which are so painfully apparent even in a generally hopeful book such as Mr. Delisle Burns has given us. F S. M.

Our Bookshelf.

Voyages of Exploration to Judge of the Bearing of Hybridisation upon Evolution. By J. P. Lotsy and W. A. Goddijn. 1 : *South Africa* (*Genetica: Nederlandsch Tijdschrift voor Erfelijkheids- en Afstammingsleer*, onder redactie von Dr J. P. Lotsy en Dr. H. N. Kooiman, vol. 10.) Pp. viii +315+11 plates. ('s-Gravenhage: Martinus Nijhoff, 1928) 35 guilders.

DR. LOTSY has undertaken during recent years many voyages of exploration seeking evidence of the frequency of hybridisation in Nature in order to assess its rôle in the creation and perpetuation of the diversity in characterisation so abundantly observable. Recently, with his colleague, Dr. Goddijn, he visited South Africa, and in the volume under notice gives an account of the many things they saw The first part of the story concerns itself with forty-three plant hybrids distributed over thirteen families.

Thereafter the authors turn to a much more interesting topic, that of hybrids between different human races, so very common in South Africa, and yet, save for the classical work on the Rehobosh, hybrids so far unrecorded. The investigation was perforce somewhat hurried, and much of that which is written is copied directly from other books which would seem to be mainly impressionistic and uncritical. However, the chief native races are divided for purposes of discussion into Bantu, Bushman, and Hottentot linneons, and it is suggested that there exist some eight tribes which have had their origin in the crossing of these Quite interesting, but definitely anecdotal accounts are given of certain white × black crosses The origin of the de Buys people, the Bastaards and Griquas, and the Cape coloured is discussed, but no really satisfactory conclusion is reached.

Finally, a number of family histories, illustrated with useful photographs, is given, and these may permit the enthusiast and the expert to identify the ancestry by recognising segregation among the progeny. This is always a simple matter in the absence of any standard type. Similarly, the coloured plates (in a separate folder) illustrating the plant and human crosses, are of more artistic than scientific value.

Science and Personality. (The Terry Lectures.) By Dr. William Brown. Pp ix+258 (London: Oxford University Press, 1929.) 12*s*. 6*d*. net.

THIS volume contains the substance of three lectures which were given by Dr. Brown in the United States in 1928 and were delivered in connexion with the Dwight H. Terry Foundation. The material there presented has been amplified by the inclusion of a selection of other papers relevant to the general theme, which is broadly a consideration of religion in the light of science and philosophy.

Dr. Brown commences by a brief survey of the present state of the physical sciences, and he then proceeds to examine the condition of the biological and psychological sciences Continuing, he deals shortly with the problems of mental unity as contrasted with mental dissociation, insisting that here is to be discerned a direct relation to the problems of unity and dissociation in the physical and physiological spheres He then proceeds to consider the various theories which have been advanced to explain the phenomena of suggestion, passing on to an examination of the claims of psycho-analysis and other forms of psycho-therapy The book ends with a discussion of personality in relation to the alleged supernormal phenomena which form the subject matter of psychical research, and in this section a full report of a sitting with the medium Mrs Osborne Leonard is printed in order to illustrate the bearing of the trance utterances upon the general question.

Although it is obvious that Dr Brown is in favour of trying to reconcile the claims of science with those of religion, it is not quite clear in what sense he uses the latter term. Again, the relation of religion to what he calls the 'universe', and the concept of value which he considers an integral part of his argument, are not sufficiently worked out to illustrate the problem of personality, and the inclusion of some very dubious examples of 'clairvoyance' towards the close of the volume tends rather to obscure than to clarify the fundamental issues

It is to be hoped that Dr Brown will return to the same theme in another place and develop individual points in his theory more fully than he has found possible in the present volume.

Vorlesungen uber theoretische Physik an der Universitat Leiden Von Prof. Dr. H. A Lorentz. Band 4· *Die Relativitatstheorie fur gleichformige Translationen* (*1910–1912*). Bearbeitet von Dr A D. Fokker. Übersetzt von Dr H. Stucklen. Pp. ix+180. (Leipzig: Akademische Verlagsgesellschaft m.b H , 1929.) 13·80 gold marks.

THIS volume is substantially a translation of the lectures delivered by Prof Lorentz in 1910–12 on what is now called the special theory of relativity, with one omission and a few additions. The part omitted dealt with gravitation, and has been withdrawn as being superseded by Einstein's general theory. One addition is an account of later experimental work on the mass of a moving electron. The results of Guye and Lavanchy (1916) on

cathode rays of high velocity are described very fully, as they are regarded as removing any possible doubt as to the truth of the Lorentz transformation formulæ Another addition, taken from later lectures, discusses a few specially difficult questions concerning tension, momentum, and energy

The special theory is so well known now that the book calls for little comment The style, as might be expected, is excellent It is characteristic of the author's modesty that he dismisses in a single sentence his own researches which preceded those of Einstein

There is one point in Prof Lorentz's presentation that is rather puzzling On p 17, and again on p 27, he strongly maintains that the contraction of a moving rod is a real effect, and not merely apparent This seems to be in direct conflict with the opinion of Eddington (cf "The Mathematical Theory of Relativity", p. 26). On p 28, Prof. Lorentz supports his view by saying that the contraction can be photographed. This perhaps establishes it as a real effect of the relative motion between the rod and the camera, but scarcely as a real property of the rod itself H T. H P

Probability and its Engineering Uses By Dr Thornton C Fry. Pp xiv + 476 (London Macmillan and Co, Ltd, 1928) 30*s* net.

UNDER the impact of numerous scientific developments, physical, biological, and engineering, the subject of probability is gradually finding a position of first importance among mathematical studies Beset as it has been with its own natural difficulties and with the conflict of views regarding its foundations held by various sections, no authoritative treatise has so far appeared that has been accepted without question by all sides. Many text-books on the subject in the past have at best been a mere collection of examples with little or no co-ordination. The present volume is the result of a course given at the Bell Telephone Company and at the Massachusetts Institute of Technology on the theory of probability as applied to electrical problems, in particular those problems that arise in the work of the telephone exchange. Although the book bears clear evidence of its origin, its utility is not in any sense limited to this field, and its applications in numerous directions are to real and useful things

The introductory chapters contain a very sound exposition of the fundamentals of the subject, and the author is at great pains to bring out the circumstances in which the purely abstracted problem of probability may or may not be expected to have its application in the real world. In later sections, averages and distribution functions, as they occur most frequently in engineering statistics, physics and actuarial science, are handled with interesting and detailed discussions on traffic density and adjustment of traffic flow, especially in relation to the work of telephone exchanges For physicists a chapter of especial interest is that giving a concise treatment of the kinetic theory of gases, with the numerous applications of probability in that field clearly set out. The book is at once clear, bright, readable, instructive, and accurate, and is certainly to be recommended.

Vertebrate Zoology an Introduction to the Comparative Anatomy, Embryology and Evolution of Chordate Animals. By G. R. de Beer. (Text-Books of Animal Biology) Pp xx + 505 (London: Sidgwick and Jackson, Ltd, 1928.) 15*s* net.

A NUMBER of topics of considerable interest in comparative anatomy and embryology have been dealt with in the researches of recent years, but, despite their importance, they have been slow in finding their way into text-books, particularly in the English language The present volume is largely concerned with these, although more generally available conclusions of fundamental importance are also included. They are discussed clearly in a series of separate chapters, some of which might be expanded with advantage, and occupy just over a third of the book.

The chapters on the embryology of *Amphioxus*, the frog, the chick, and the rabbit as illustrating different types of development, and those on the evolution of the various classes of chordates, are written in an interesting manner. The early chapters, giving descriptions of nine different forms, are very brief and will not be of much service to the student although they may help the layman to appreciate the discussions in the subsequent pages. Some of the illustrations are not up to the standard that might be expected in a work of this description, and here and there are statements that are ambiguous or incorrect

The book furnishes the general reader with a good review of the present ideas in chordate morphology, and the student of zoology will also find much that is of interest and use to him in his studies

A Study in Tubercle Virus, Polymorphism, and the Treatment of Tuberculosis and Lupus with Oleum allii. By Dr. William C Minchin Third edition. Pp. xvi + 110 + 26 plates (London: Baillière, Tindall and Cox, 1927.) 25*s* net

THE main thesis of this book is that the bacillar one is not the only form of the tubercle bacillus, and that minute spherical granules are extruded from the bacillus, which undergo a cycle of development consisting of division, budding, and protrusion of tubular structures As regards the granules, the author's observations are probably correct and are confirmatory of those of Spengler, Much, and others, and of the more recent work which suggests that there is a 'filterable' stage of the tubercle bacillus. The development cycle seems much more problematical and needs confirmation. For the treatment of tuberculous conditions, the author extols an old remedy, oil of garlic, and produces sufficient evidence of its clinical value to suggest that it is worthy of more extended trial The book is illustrated with a number of excellent plates, though it is questionable if the high magnification (×4000-5000) employed in the photomicrographs is of much value, as resolution is not increased thereby and there is some loss in definition.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Distribution of Temperature in the First 25 Kilometres over the Earth.

IT is with much pleasure that I notice in NATURE of June 1, p. 834, Dr. Ramanathan's amplification and correction of the tropical portion of my diagram of distribution of temperature in a vertical section of the atmosphere of the globe from the summer pole to the winter pole. I hope the time is not far distant when some other enterprising meteorologist will render a like service for the polar regions of that diagram. It is badly needed.

While, however, we are waiting for that amplification, it would be very helpful if Dr. Ramanathan would supplement his contribution by additions and corrections within his knowledge to another diagram, namely, that of lines of equal entropy in a similar section which will be found on p. 116 of the volume to which he refers

My reason for asking for this particular service is that, in order to deal with the physics of the upper air, the distribution of temperature alone is not sufficient, the corresponding values of pressure come into consideration too; and the best form in which the information about pressure can be conveyed is by a corresponding diagram of isentropic lines which can indeed be superposed without risk of confusion upon the isothermal lines already drawn.

In explanation let me say that everybody recognises that convection is a primary feature of weather, and we are accustomed to think of temperature enhanced beyond that of the environment as the natural preliminary to convection. So it is; but it is temperature in relation to pressure—entropy, in fact—that really counts. It is entropy which decides the equilibrium position of a sample of air, whether it will rise or sink or stop where it is in a particular environment. Entropy depends on temperature and pressure. It is reduced by reduction of temperature, but enhanced by reduction of pressure in accordance with algebraical formulæ which are quite easy to work, and are set out in the report of the recent Leipzig meeting of the International Commission for the Exploration of the Upper Air. The physical significance of an isentropic surface in the atmosphere is that air cannot pass upward from it without access to a supply of heat, nor downward without getting rid of heat. Circulation along an isentropic surface on the other hand can take place without any communication of heat, no matter whether the controlling surface be horizontal or vertical at the position of the sample. Convective equilibrium is the name which our predecessors gave to an isentropic condition in the vertical, and no energy is required for motion where there is convective equilibrium. We are accustomed to think of convective equilibrium as characteristic of a considerable horizontal area; but that can scarcely be so—differences arise from variations in surface-temperature, height, or solarisation, and the minutest difference in a region of convective equilibrium is dynamically operative.

Hence the lines of equal entropy in a vertical section are a guide to the conditions of the circulation of air and may be regarded as essential to the comprehension of the physics of the atmosphere.

Doubtless, in order to deal with particular conditions, diagrams of isentropic surfaces for the particular occasions are necessary, and they can be provided as soon as we can get maps of the distribution of pressure and temperature at successive levels. The diagram of normals is not the final step, but it is at least a first stage, and an important one in the prosecution of productive inquiry, I trust that Dr Ramanathan will find an opportunity for providing it. Personally, I require the information for tracing possible tracks of air elevated by convection in the tropical regions and descending somewhere else I have a place ready for it, and if he will supply it I shall be correspondingly grateful NAPIER SHAW.

10 Moreton Gardens, S.W 5,
June 3.

An Ancient Spearhead.

IN the British, London, and Aylesbury Museums are a few iron spearheads, presumably of the Early Iron Age, and evidently copied from the cast-bronze spearheads of the late Bronze Age, which ended about 800 B.C. in Britain. All of these were found in England. Mr. Reginald A. Smith, Keeper of British and Medieval Antiquities, British Museum, informs me that their occurrence has long been a mystery; that, on one hand, it is difficult to account for their

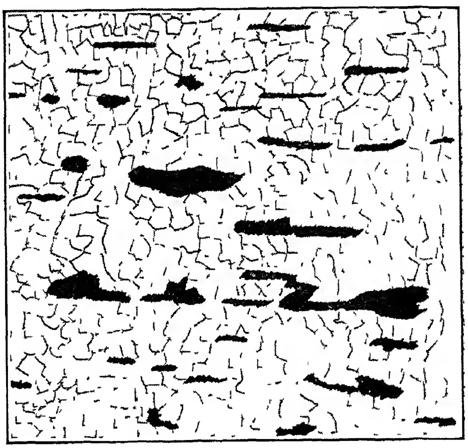

FIG 1.

shape in wrought iron by reason of the high degree of technical skill required for their manufacture in this way, and that, on the other hand, cast iron, of which they may possibly be composed, is supposed to have been unknown even in medieval times.

I was recently approached by him to know whether it would be possible to put this matter to the test, and a specimen in the British Museum from Golden Lane, City of London, was selected for this purpose. The weapon in question is a narrow leaf-shaped spearhead of Bronze Age type, $7\frac{1}{2}$ inches in length, having a short round socket with flattened sides which are pierced by two holes for a rivet. The blade has a mid-rib extending to the tip, and inside the socket tapers for a length of $5\frac{1}{2}$ inches. Its approximate date is 7th century B C. It may be a century or two later, but scarcely earlier.

There was no difficulty about preparing a surface suitable for microscopic examination, although owing to the regulations the specimen itself could not be taken out of the Museum, and the necessary work had to be done there. For this reason it was not

possible to photograph the actual structure obtained. The section examined was parallel to the surface of the spearhead and about half-way between the tip and the broadest point. A sketch of the microstructure was made with great care by my assistant, Dr. J. M. Robertson, and from this the accompanying photograph (Fig. 1) was prepared. The structure shown is at a magnification of 120 diameters. It is typical of wrought iron. The black elongated areas with somewhat serrated and rough edges represent the slag threads which have been elongated in the direction of working. The small irregularly shaped polyhedra are the crystals of iron. There is no doubt, therefore, that this particular spearhead consists of wrought iron, and not of cast iron.

Without a complete examination and consequent destruction of the spearhead, it is impossible to ascertain how the forging was done, but there are certain features of the specimen itself which suggest two possible methods of forming. The hollow centre of the rib extends to within a short distance of the point of the spear and tapers with the rib, so that the metal of the rib is of approximately the same thickness throughout its length. It would appear that this hollow in the rib is a consequence rather than an object of the method of forging, and it indicates that the forming was carried out on a mandril of metal or stone. Two alternative methods of forming may be considered In the first the spearhead could have been made from a long strip bent back over the mandril and forged down at a welding heat In this way the head would be formed from one piece of metal; the leaf-shape would be obtained by chipping or grinding; the joints would correspond with the edge of the spear and a mandril would be necessary to form the central rib. In the second, the mandril may have been used to pierce a billet of suitable size and have served as a means of holding the metal during forging and as an aid in forming the rib.

Whatever method of forging was in fact adopted, the crystal structure of this spearhead is very similar to that of a wrought iron produced at the present time. It is impossible not to admire the skill of the earliest iron workers who produced results such as this.

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The Dehydration of Benzene.

PROF. H. B. BAKER has shown that prolonged contact between benzene and phosphorus pentoxide results in a marked rise in the boiling-point of the liquid. From this we may safely infer that corresponding and concurrent variations in other physical properties, such as the refractivity, freezing-point, and specific volume, take place during the process of dehydration.

To test the accuracy of this supposition, I have during the past year carried out many determinations of the refractivity of benzene in the presence of pure phosphorus pentoxide. For this purpose use was made of (*a*) a hollow prism and refractometer readable to 1″ of arc, and (*b*) a Jamin interferometer by Hilger capable of measuring to within ⅒th of a fringe. For each series of experiments the benzene bought as 'pure' was re-purified and subjected to a preliminary drying by calcium chloride

After introducing the benzene into the prism or interferometer, a first determination of the refractivity was made. Pure phosphorus pentoxide was then placed in the liquid, and additional and periodic measurements of the refractivity effected. Data thus obtained during an interval approximating six months, proved that as a result of exposing the benzene to the action of the dehydrating reagent the refractivity changed continuously. On plotting refractivities against time, the resultant graph consisted of two distinct portions or limbs, both smooth, but having very different directional values. A study of the whole graph has led to the conclusion that the first limb represents the rate of the removal of the mechanically admixed water, and that the second limb offers a measure of the rate of the withdrawal of water in actual combination with benzene. In other words, the first limb of the graph is indicative of the rate of drying as ordinarily understood, and the second the rate of true dehydration. Whence it appears that during my experiments the benzene under observation behaved as does a wet crystallised salt, such as copper sulphate when exposed to air.

The results so far obtained clearly indicate that, within some as yet undetermined range of temperature, benzene firmly combines with water, and thus forms one or more hydrates. This conclusion is strengthened in consequence of some preliminary measurements of the specific volume of benzene in the presence of phosphorus pentoxide. This physical 'constant' is found to be dependent upon the temperature to which the benzene has been exposed *immediately before* the determination is carried out. For example, I find that the normal specific volume at 18° C. is lessened by a preliminary cooling of the benzene in melting ice, and increased when the liquid is first heated to 21° C. Whence it appears, first, that during crystallisation, combined water is ejected from the benzene and taken up by the phosphorus pentoxide; and secondly, as the temperature is raised from 0° to 21° C., the process of dehydration is reversed so that the benzene is rehydrated by the withdrawal of water from the newly formed metaphosphoric acid. From this it follows that the drying power of anhydrous benzene is, within certain limits of temperature, greater than that of phosphorus pentoxide.

During precisely similar experiments conducted with benzene in the absence of phosphorus pentoxide, the changes in the specific volume, although in kind the same, were relatively quite insignificant.

These investigations are being extended, and in due time I hope to give a detailed account of the work elsewhere.

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The Intensive Drying of Liquids.

THE well-known work of Prof. H. B. Baker on the properties of liquids and solids which have stood for long periods of time in closed vessels with phosphorus pentoxide is of the greatest importance to chemists. Since the publication of Prof. Baker's 1922 paper, in which he reported a remarkable change in some of the physical properties of ten liquids which had been dried for from eight and one-half to twenty-eight years with phosphorus pentoxide, the problem of the influence of traces of water on pure chemical substances has been of controversial interest. Several authors have described experiments which are interpreted as confirming Prof Baker's work (Smits, *J. Chem. Soc.*, **125**, 1068, 1924 · Mali, *Z. anorg. Chem.*, **149**, 150, 1925. J. W. Smith, *J Chem. Soc.*, 867, 1928), while I have not been able to check this work (Lenher and Daniels, *Proc Nat. Acad.*, **14**, 606; 1928) with benzene and carbon tetrachloride which had been dried for from four to four and one-half years (1923–1928). The difficulties of repeating Prof. Baker's experiments are very great, because

experiments carried out in a drying time less than that taken by him, which do not effect a change in the dried liquids, can always be met with the practically unanswerable criticism that intensive drying had not been obtained

I have no reason to believe that the liquids described by me in the *Proceedings of the National Academy of Sciences* were not intensively dried In fact, if one accepts the work of Smits (loc. cit.) the liquids which were sealed up with phosphorus pentoxide in 1923, and were examined in 1928 by me, were certainly intensively dried, though no change in the physical properties of these liquids was observed As I could see no explanation of my results other than the obvious conclusion that the boiling point of dried liquids and undried liquids is the same when superheating is effectively prevented, there remained the difficulty of explaining Prof. Baker's remarkable results. Experiments were performed to see if the effects reported by him could not be obtained under similar experimental conditions with ordinary liquids. These experiments, a full description of which will be published shortly in America, show that ordinary pure benzene, carbon tetrachloride, and water give apparent boiling points as high as 27° above the normal boiling point when measurements are carried out in a reproduction of the apparatus described by Prof. Baker and Prof Smits. I have repeated the crucial experiment of Baker and Smits (Smits, loc. cit.; Baker, *J Chem. Soc.*, **123**, 1223, 1923) with exactly the apparatus and procedure described by them, using ordinary benzene, and I have observed the same phenomena. There can be no doubt that what is interpreted by these authors as a fractional distillation of dried benzene is superheating of benzene, for the same effect is obtained with ordinary pure benzene.

The conditions which are favourable to this apparent rise in boiling point have been studied and will be described at length elsewhere. Some of these conditions are: (1) the use of a heating bath; (2) the immersion of the thermometer bulb in the liquid the boiling point of which is being measured, (3) allowing a liquid to stand in contact with a flocculent solid, such as redistilled phosphorus pentoxide, which will remove dust particles (Spring, *Rec. Trav. Chim. Pays-Bas*, **18**, 233, 1899), and (4) distillation of the liquid into a clean flask before determining the boiling point, which tends to free the liquid of dust particles which act as centres for the formation of bubbles to initiate boiling (Martin, *J. Phys. Chem.*, **24**, 478, 1920).

I have repeated and extended Prof. Baker's experiments on benzene which has been subjected to a high direct current potential (*J. Chem. Soc*, 1054; 1928). The boiling point of benzene subjected to a potential of 450 volts direct current for more than twenty-four hours in a reproduction of Prof. Baker's apparatus was found to be unchanged, namely, 80° to 80·2°, when heating was carried out with a platinum wire heating element under conditions where it is known there is less than 0 03° of superheating. When boiling point determinations were carried out both on benzene subjected to the direct current potential and ordinary benzene with no potential applied in an identical apparatus, using a heating bath (Prof. Baker seems to use a heating bath in his boiling point determinations), no difference which could be attributed to the influence of the potential was observed; both tubes were easily heated 10° to 25° above the boiling point of benzene before ebullition began. One is forced to conclude not only that there is no real change in the state of liquids subjected to a high direct current potential, but also that the original measurements were carried out under conditions where superheating is practically unavoidable.

It does not seem necessary here to consider the theories of Prof. Baker and Prof. Smits on the intensive drying of substances, but this matter, together with additional experiments and a review of the published evidence for the change of some of the physical properties of liquids on prolonged drying, will be dealt with in the forthcoming paper referred to above

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X-ray Evidence for Intermolecular Forces in Liquids.

DIFFERENT mathematical methods[1-5] have been used to express the conception of the 'structure of a liquid' in exact formulæ, mainly with the intention of accounting for the X-ray diffraction pattern The different treatments, however, have a common principle, which for our purpose may be stated in the following way. The arrangement of the molecules in the liquid, and of the electrons in the molecules, causes a non-uniform distribution of scattering power in the liquid This distribution may be resolved in a continuous range of periods in a way analogous to, but not identical with, ordinary Fourier analysis In X-ray terminology these periods may be called 'spacings', if properly defined each of them is related to a certain diffraction angle by the well-known Bragg relation, and their strength is measured by the corresponding intensity in the diffraction pattern

We will confine ourselves to molecules which do not differ *very* much in shape from spheres Then the most prominent spacing is due to the mutual distance of neighbouring molecules, and it is indeed this spacing which accounts in most cases for the 'principal halo', as has been put on firm ground for the first time by an experimental study of Keesom.[1]

The interpretation of the diffraction pattern *outside* the principal halo is complicated by the fact that here the 'inner structure' of the molecule, mentioned above, may also play a part. On the contrary, I wish to emphasise that this influence must be negligible in the region of the pattern *inside* the principal halo. This arises from the fact that if the inner structure is resolved into 'spacings', these are of course mainly shorter than the intermolecular distances. Therefore it may be stated that *the diffraction pattern of liquids inside the principal halo is only related to the mutual arrangement of the molecules.*

This circumstance suggests the possibility of applying some theoretical considerations. First, it has been shown [2,4] that for the case of *very* small diffraction angles the intensity must approach a definite limiting value, which may be calculated from the compressibility of the liquid, and is ordinarily about five per cent or less of the intensity that would result if the scattering of all molecules were incoherent. But we may perhaps go a little further, at least when the intermolecular forces may be neglected (except of course in so far as they prescribe a definite volume for a definite quantity of molecules). To this end we compare our problem with the analogous one-dimensional case,[4] where the required calculations are easily carried out rigorously, and show that, when we proceed

[1] W. H Keesom and J de Smedt, *Proc Amsterdam*, **25**, 188; 1922 W. H Keesom, *Proc Amsterdam*, **30**, 341, 1927
[2] C V Raman and K R Ramanathan, *Proc Ind Assoc for Cultiv Science*, **8**, ii 127, 1923
[3] P Debye, *Jour of Math and Phys*, Massachusetts, **4**, 133; 1925, and *Phys Zeitschrift*, **28**, 135, 1927
[4] F Zernike und J. A Prins, *Zeitschr f Phys*, **41**, 184; 1927
[5] G W Stewart, *Phys Rev*, **32**, 558; 1928.

from the principal maximum to smaller angles, the intensity falls off continuously and rather rapidly to the limiting value already mentioned. There is no reason to suppose that this should be radically different in three dimensions.

With the view of testing these points I have recently examined the diffraction pattern of many liquids at small diffraction angles and have arrived at some results that seem interesting enough to communicate to NATURE. As an example let us take water (here it is chiefly the arrangement of the oxygen atoms that determines the diffraction pattern) It is well known that the principal halo of water lies at a diffraction angle to which corresponds a spacing of about 3 A, in good agreement with the mean intermolecular distance I have found, however, that at the inner side of this halo the intensity is rather strong and roughly constant till a very small angle is reached, corresponding to a spacing of about 17 A. At this angle the intensity falls off rapidly, and for still smaller angles approaches a limiting value which may be assumed with some reason to agree with the theoretical limiting value considered above But how are the spacings between 3 and 17 A to be explained? We have already seen that we certainly must look for an explanation in the arrangement of the molecules A closer examination shows that this arrangement must be of the following kind in the immediate neighbourhood of every molecule the mean density must be greater than at greater distances. This arrangement may be described as a 'tendency to association', though I think this is mostly to be understood in a dynamical rather than in a statical sense. The reason of this arrangement is, of course, to be found in the nature of the attractive intermolecular forces.

The same strong scattering inside the principal halo is found with many other liquids, and recently it has also been remarked by Krishnamurti[6] that with liquids classified from other reasons as 'associating' it is often so strong as to give rise to an 'inner ring'. This agrees with the explanation given above

I should like, however, to point out, that a scattering inside the principal halo, stronger than the limiting value, though much weaker than in the previous cases, is present also with liquids, as benzene, carbon tetrachloride, carbon bisulfide, and others,[7] which are usually not called 'associating'. Indeed the only exception known to me is that of mercury. From this it would seem that in the X-ray pattern we have a much more sensitive method for studying the intermolecular forces than in many other methods. Perhaps we may hope in due time to be able to draw more definite conclusions from it. In this respect it might even sometimes serve us better than the diffraction pattern of the solid state

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Groningen.

[6] P Krishnamurti, *Ind Jour Phys*, Calcutta, **2**, 491, 1928 In another paper Mr Krishnamurti has also studied solutions from the same point of view as I did in a previous letter to NATURE (*Ind Jour Phys*, Calcutta, **3**, 209; 1928, NATURE, **123**, 84, 1929)

[7] As a curious fact it may be mentioned that organic iodides seem to show an inner ring while bromides do not, even if the molecules are rather long (for example, C_{13}-dibromide) For the longest spacing of C_{13}-dibromide in solid state I found 12 6 A, this low value probably indicates that the CH_2-chain is not straight in this compound

X-ray Pattern of Metallic Crystals.

WHILE reading the literature on diffraction of X-rays, I came across interesting photographs of X-ray patterns for a few metallic foils—aluminium, cadmium, copper, lead, silver, thallium, tin, zinc, and several kinds of brass—at different temperatures (Nishikawa and G. Asahara, *Phys. Rev*, 1920). The most interesting fact one finds from this paper is that there is a remarkable change in the nature of the pattern for a metal as time elapses after the rolling process Silver and tin, for example, gave ill-defined patterns immediately after the rolling process, but these gradually changed during the following two or three weeks to the distinct spot patterns characteristic of annealed samples. Nishikawa and Asahara conclude from this that for these samples the crystal growth which accompanies annealing takes place at room temperatures

We had in our laboratory a few metal foils kept at room temperature for about twenty years. This is indeed a sufficient time for the complete recovery of the foils after the process of their production, and a beautiful spot pattern was expected. Patterns for a few metallic foils were therefore taken. For this purpose a Hadding tube with a copper anticathode was worked at about 85 kv. and 10 ma A strong beam of X-rays was allowed to pass through the material The pattern was recorded on a photographic plate kept at a distance of 3 cm. from the leaf. Silver and gold gave a ring pattern; the rings were quite continuous and there was no indication of any spots on the plate In the case of tin (grey) the pattern was mostly similar to No. 27 of Plate 1 of the paper quoted above, and not spots as in No 27′. For gold and silver the rings were not only of similar nature but were also of identical diameter. The diameter of the inner ring was 3·7 cm, and that of the outer one 4·5 cm. The intensity of the inner ring was about ten times the intensity of the outer one From these facts one is tempted to draw the following conclusions

(*a*) For silver and gold the lattice is the same, and is the same in magnitude. This is borne out by the experiments made by L Vegard in a different way (*Phil. Mag.*, 32, 1920) (*b*) These metals do not recover from the effects of the process by which the leaves are made, using the terminology of Nishikawa and Asahara (*c*) It is more proper to regard a thin metal leaf as an assemblage of metallic crystals as in the case of powders, for which by Hull's method we always get a ring pattern.

Taking d as the lattice constant responsible for the production of both the rings, we find that $\sin\theta/\sin\theta' = 0\ 87$, which is about the same as Cu($K\beta$)/Cu($K\alpha$). It thus appears that the two rings are due to $K\beta$ and $K\alpha$ lines of copper.

G. B. DEODHAR.

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Allahabad (India).

Emission Lines in the Spectrum of the Solar Corona.

IT seems very improbable that the bright line spectrum of the inner corona can be attributed to thermal excitation of the coronal matter We may seek its cause in the process of photoelectric ionisation and apply then, as a first and rough estimate of its brightness, the same analysis as Dr Zanstra has done in the case of diffuse nebulæ (*Astrophys. Jour*, **65**, No 1). Thus we assume in this approximation that the emission spectrum of the corona is due to a mechanism of recombination of free electrons with atoms, ionised by the high quantum radiation, emerging from the sun, acting as a black body radiator, and that the corona consists only of monoatomic hydrogen. We have to suppose, further, that the high quantum radiation is completely absorbed by the coronal material, and that all the freed electrons recombine with the ionised hydrogen atoms.

With these assumptions we can apply Zanstra's formula for the ratio of the integral brightness of the corona to that of the sun

$$=\frac{h\nu}{kT},$$

where T is the sun's effective temperature; h and k are well-known constants; ν_0 will be in our case the frequency corresponding to the head of the Lyman series ($32{\cdot}84 \times 10^{14}$); ν_1 and ν_2 are the limits of frequency for photographic rays ($\nu_1 = 5{\cdot}95 \times 10^{14}$ and $\nu_2 = 9{\cdot}10 \times 10^{14}$). Expressing L in differences of stellar magnitudes Δm we get:

T	Δm	m_c
6400	18·0	−8·0
6200	99·1	−6·9
6000	20·0	−6·0
5800	20·8	−5·2

(m_c is stellar magnitude of the corona; $m = -26{\cdot}0$ mag.)

We can conclude from these data that even in the case of lowest admissible effective sun's temperature, we should obtain on the plates the effect of a relatively faint but characteristic bright line spectrum, superposed on the continuous spectrum of the corona (Russell, Dugan, Stewart, "Astronomy", vol. 2, p 507).

It should be noted that the proposed explanation of the bright coronal lines is related to a fact noticed by Balanovsky and Perepelkin (*Mon. Not. Roy. Ast Soc.*, **88**, p. 747), namely, that the coronal material seems to be attracted by the solar prominences. This may be due to the fact that a part of the high frequency quanta, being absorbed by the prominence, does not reach the coronal matter and produces a darkening of the corona over the prominences. In that case the coronal emission lines ought to weaken considerably above a prominence, and such an effect, if observed during an eclipse, would afford a proof of the photoelectric origin of the coronal emission spectrum.

W. ZESSEWITSCH.

University Observatory,
Leningrad

W. NIKONOW.

Astronomical Institute,
Leningrad, April 29.

Growth-gradients and the Axial Relations of the Body.

IN previous communications (see Huxley, 1927, *Biol. Zentralbl*, **47**, 151) it has been pointed out that in Crustacea the presence of a centre of active growth,

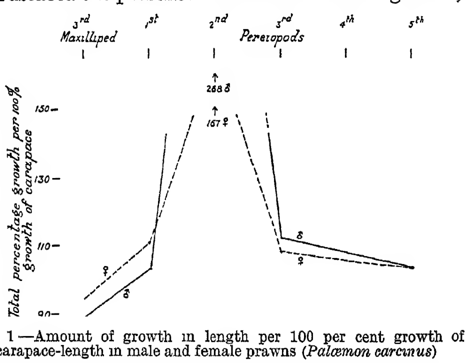

FIG 1—Amount of growth in length per 100 per cent growth of carapace-length in male and female prawns (*Palæmon carcinus*)

for example, in a male chela, is associated with excess growth of the other walking legs The third maxilliped however, is not affected in this way, but appears to be slightly decreased in the male. The question arose whether this was a positional effect, appendages anterior to the growth-centre being inhibited in their growth, those posterior being accelerated, or whether, since the maxilliped was an appendage of different type from the pereiopods, its growth was not correlated with theirs

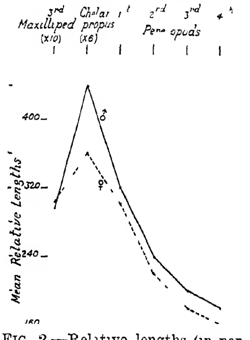

FIG 2—Relative lengths (in per cent of carapace-length) of male and female spider-crabs (*Inachus dorsettensis*) After M E Shaw, *Brit Jour Exper Biol*, **6**, 145

To settle this question, measurements have been made on a large Indian species of *Palæmon* (*P. carcinus*) in which the second pereiopod, not the first, is enlarged as the male chela The material was presented by the Zoological Survey of India, through the kindness of Col Seymour Sewell

The results appear quite definite For 100 per cent increase in carapace-length, the percentage increase in length of the various limbs measured are as follows

	Maxilliped	Pereiopod				
	3rd	1st	2nd	3rd	4th	5th
♂	89 0	103 2	*268 0*	*112·2*	*107 8*	*103·2*
♀	*94 6*	*111 1*	167·0	108 1	105 2	103 1

The accompanying diagram (Fig 1) shows the results graphically. Fig. 2 shows the effect in *Inachus*, where the first pereiopod is the large chela. Other methods of analysing the figures confirm this conclusion; namely, that exceptionally active growth in one appendage is correlated with a slight acceleration of growth in the appendages posterior to it, a slight retardation in those anterior

It has previously been established that the heterogonic growth of an appendage takes place most rapidly in a 'growth-centre' near its tip, and that there is a 'growth-gradient' down from this region towards the trunk. It would thus appear that when the local growth-gradient of the appendage reaches the trunk, it is influenced by the axial relations of the whole animal, and affects the regions posterior to the appendage in a different way from those anterior to it. No view has as yet been put forward as to the mechanism of this influence, and we should welcome any suggestions bearing upon it.

J. S. HUXLEY.
M. A. TAZELAAR.

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King's College, London.

Growth and Longevity of Whales.

ACCORDING to Mr N. A. Macintosh (British Association Report, 1928) Blue whales and Fin-whales grow quickly and probably reach maturity in the short space of two years; Mr. Macintosh's statement implies that, in favourable circumstances, these great animals might increase in number fairly quickly, but that they die without attaining any great age.

In the case of the Greenland whale the duration of gestation and lactation are unknown, but the following facts suggest that it takes more than two years to reach maturity, that it multiplies very slowly, but that it attains a considerable age

1. So far as can be ascertained now, the Greenland

whale is 14 or 15 feet long at birth, is about 20 feet long and its whale-bone less than 2 feet long when it is weaned, but is not sexually mature until its length is about 50 feet and its whale-bone exceeds 10 feet

2 As stated in my letter on the "Extermination of Whales" (NATURE, Mar. 2) in the Greenland Sea in the period 1860–1909, only a small number were killed by the whalers, including those that may have died after breaking loose, two or three less than ten a year, and that notwithstanding this small mortality at the hands of their human enemies in these years they showed no signs of increase. It might be objected that the whalers were not the only enemies of the Greenland whale and that others came to an untimely end in other ways, but of this there is no evidence. In the Greenland Sea the Killer whale, its most likely enemy, is not found amongst the ice, and as far as I saw the whales do not appear to suffer or die from disease. Only those that died from harpoon wounds were found floating dead.

3. Harpoons were sometimes found in whales, which the animals appear to have carried about buried in them for a long time.

In the Greenland Sea, in 1863, my father killed a large whale in which he found an old harpoon marked 'Pow and Fawcus, Newcastle, 1839', and in 1872 he killed two others, also large, in each of which he found old harpoons (Buckland's "Log-book of a Fisherman", etc, p. 247).

In Davis Strait in 1894 the *Terra Nova* killed a large whale (12 feet bone), in the blubber of which was found embedded a harpoon bearing the name 'Jean of Bo'ness', and dated forty years back. The *Jean*—a well-known whaling ship—was lost in Davis Strait in 1857 (*Zoologist*, 1895, p. 94).

ROBERT W. GRAY.

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Exmouth

Reduced Flowers of *Ranunculus*.

I AM glad my letter to NATURE (April 13, p. 568) has been the means of eliciting from Mr Marsden-Jones and Dr. Turrill a very interesting joint communication (NATURE, May 25, p 798) on the above subject. I hope I have not unwittingly been attempting to steal their thunder !

The references to the literature they give are very welcome. Apparently these buttercup plants with reduced (female) flowers have hitherto failed to interest British field botanists—an instance perhaps of the lack of sympathetic feeling and co-operation between the systematists and the geneticists.

As yet I have not come across in this district the reduced form of *Ranunculus bulbosus*, but shall keep my eyes open now that the buttercup season is with us. Plants of *R acris* with the small flowers and aborted stamens are appearing as usual.

If there be evolutionary significance in these reduced flowers, then seeing there are all grades between plants with completely hermaphrodite flowers and those with no functional stamens, it looks as if there is here an example in support of the view of "the inevitability of gradualness" (to adopt a famous phrase used in another connexion) in evolution

The writers of the joint letter express surprise at my not mentioning a freak plant of *Ranunculus acris* I found here in the middle of a pasture field a few years ago. Reference to such a plant did not appear germane to the subject matter of my former letter, for I regard it as a sport which has no bearing on the evolutionary trend of the species Others naturally may take a different view. It is pleasing, however, to know that it is of value to these workers on the genetics of the genus, especially as they have proved it to be functionally male only—a point which was not obvious to me at the time of its discovery. The original plant is still in the garden here. It does not grow nearly as strongly as the ordinary or reduced (female) form of *Ranunculus acris*; consequently in the wild state it might soon have failed to hold its own and been squeezed out of existence. It was a frail affair when I lifted it from the pasture. A feature of it not mentioned in the Marsden-Turrill letter is the distinctive character of its foliage. The leaves are somewhat crested and less sharply cut than those of the type, so that the plant can readily be recognised when not in flower.

J. PARKIN.

Blaithwaite,
Wigton, Cumberland,
May 29

Nervous Impulse in *Mimosa pudica*.

IN a letter under the above heading (NATURE, April 13, 1929) Prof Hans Molisch describes certain experiments which appear to confirm the earlier work of Sir J C. Bose Space does not permit of a full discussion of these results, but it is rather surprising to find that Prof. Molisch regards the experiment of Bose on the supposed reflex arc as satisfactory evidence, since the fallacy in this experiment has already been demonstrated by K Umrath (*Planta*, **5**, 1928, p. 295, footnote)

As Umrath points out, and as I also have found, the serial reactions of the pinnæ take place in the same way, whether one stimulates a pinna of a leaf attached to a shoot or one from which the main pulvinus has been removed. This fact disposes of the contention that an afferent impulse is changed into an efferent one in the main pulvinus. Further, neither Sir J C Bose nor Prof. Molisch mentions the reactions of the secondary pulvini. I have noticed that if one stimulates one pinna, either electrically or by cutting, in the large majority of cases the secondary pulvini of the other pinnæ react *before* the main pulvinus, thus showing that the excitation has already reached them. As Umrath points out, there is a delay in the transmission between the secondary pulvinus and the basal pair of pinnules This delay allows time for the excitation to reach the main pulvinus, which thus reacts before the excitation is apparent in the pinnules on the unstimulated secondary petioles.

Occasionally I have observed the excitation beginning to pass up the unstimulated pinnæ before the main pulvinus reacts, but usually the time which has elapsed is not sufficient for it to pass beyond the secondary pulvini.

It is therefore apparent the transition of the excitation from one pinna to another takes place at the apex of the petiole and not through a reflex arc passing through the main pulvinus

NIGEL G. BALL.

Ceylon University College,
Colombo, May 7

The Ratio of the Mass of the Proton to that of the Electron.

IN a recent paper (*Proc. Roy. Soc.*, **122**, p. 358; 1929) Prof. A. S Eddington reached the conclusion that the value of the physical constant $ch/2\pi e^2$ is given by the integer 136. His theory reduces the evaluation of this constant essentially to the counting up of symmetrical elements in a square array. The numbers

of such elements in arrays arising in this connexion are 10, 136, etc.

In this light, it is interesting to speculate if at least some of the dissimilarities between the proton and the electron are not somehow bound up with the question of degrees of freedom, and, in particular, if another important non-dimensional physical constant, namely, the ratio of the mass of the proton to that of the electron, M/m, cannot be accounted for by counting up elements and by performing simple operations with the numbers so obtained. If so, it is plausible to assume that M/m should depend on two such numbers, one of them being 136 The other number here taken is 10, as the absence of protonic spin hints at the smaller value With these two integers on hand, and with the observed value of M/m (1840, roughly) in mind, it is tempting to write .

$$\frac{M}{m} = \frac{(136)^2}{10} = 1849\ 6.$$

I am aware of no proof of this relation. But as I do not, at present, know of any reason for ascribing the numerical result, without at least some hesitation, to a mere coincidence, I believe that the numerical agreement in this ' empirical ' relation warrants notice.

V. ROJANSKY.

Washington University,
St. Louis, U.S.A ,
April 26.

Freshwater Medusæ in England.

IN NATURE for Jan. 12, Prof. Hickson has recorded freshwater medusæ and their polyps from Mr V B. Poulton's aquarium at Boscombe. Afterwards these were assigned to *Craspedacusta sowerbii* after comparison with drawings made at the British Museum of polyp stages of that species found last summer on *Pandanus* roots in the *Victoria regia* tank of the Royal Botanic Society and exhibited at a meeting of the Zoological Society.

The Boscombe polyps afford additional confirmation of the evidence for linking up Sir Ray Lankester's Regent's Park medusa with the polyps of Bourne, Parsons, and Fowler, since they bear medusa-buds.

In case any other amateur should observe freshwater medusæ in England it is to be hoped that it will occur to him to communicate with the British Museum. It seems highly probable that *Craspedacusta* occurs in a wild state in British river systems, and it would be well if a sharp look out for it were maintained.

A. K. TOTTON.

British Museum (Natural History),
London, S.W.7, May 13.

The Crystal Structure of Nickel Films.

FILMS of nickel deposited on rock salt by spluttering in residual gas or argon, show an unexpected structure on removal from the rocksalt and examination by the cathode ray diffraction method. As is well known, the normal structure of nickel is face centred cubic, as found both by X-ray and electron diffraction methods. The new structure turns out to be hexagonal, the values of the axes being $c = 4\ 06$ A., $a = 2\ 474$ A. ratio 1·64, which is near enough to the ratio 1 633 for closest packing. Nickel thus resembles cobalt in crystallising in both cubic and hexagonal closest packing. The density calculated from the above axes is 8 86, in good agreement with that of the metal in bulk. The structure is thus different from an hexagonal form found by Bredig and Allolio (*Zeit f. Phys Chem* , **126**, p. 53; 1927) by spluttering in hydrogen The latter had a density of only 7 04 and is probably a hydride. The above is, I believe, the first case of a new crystal form found by electron diffraction.

G P THOMSON.

University of Aberdeen,
May 31.

A Proposed Survey of the Burnet-moths.

I AM at present undertaking a survey of the variations in the male and female genitalia and in the wing patterns in the genus *Zygæna*, or Burnet-moths. This necessitates the collection of specimens from as many parts as possible of the British Isles and continent of Europe I should therefore be very grateful if specimens could be sent to me this summer. They should be taken *in pupa* and, if possible, at least two dozen from one locality or colony. It is very necessary that pupæ from neighbouring or different colonies should be kept separate Details as to the position and extent of the colonies would be welcome so that they can be identified afterwards on Survey maps Pupæ may be taken on the grass stems, packed in a small box and sent to the address below. Due acknowledgments to the collectors will be made of course in resulting publications.

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S W.7.

The Emission of Positive Ions from Metals.

DURING the study by me of critical potentials in metallic vapours (*Phys. Rev.*, August 1928), it was noticed that positive ions were given off by heated metals and that these ions persisted for very long periods of heat treatment. A determination of e/m of the positive ions from heated metals gives the following results. Copper, iron, nickel, and platinum when heated, give alkaline ions only, as has been found by other observers. Tungsten, molybdenum, and tantalum when heated to a temperature where vaporisation becomes appreciable, give ions the atomic weights of which agree with that of the metal emitting them. Other metals are under investigation.

H B WAHLIN.

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Madison, Wisconsin, U.S.A.

Adder or Nether.

IN his note upon dragonflies in NATURE of June 1, Dr. Tillyard asks whether the adder is still called the ' ether ' in any part of England. I cannot answer for England, but ' nether ' is good Lowland Scots for ' adder ', and is given in that sense in Jamieson's " Dictionary of the Scottish Language ". Among examples given by Skeat of initial *n* shifting from the noun to the indefinite article, or from the article to the noun, he mentions *addere* and *naddere* as interchangeable forms in Middle English , but he says nothing on the question whether ' adder ' comes from Anglo-Saxon neoðera, nether—the lowly one.

HERBERT MAXWELL.

Monreith, Wigtownshire.

The Hormones of the Sexual Glands.

RECENT work on the internal secretions of the gonads illustrates the fact that progress is only rapid when a simple specific test for the principle under investigation is available The earlier reports of the isolation of an ovarian hormone failed to arouse the interest of more than a few workers, since the test of activity used, the growth of the female genital tract following injection of the extract into an immature or adult normal animal, was liable to the fallacy that such growth might have occurred naturally, whilst even in spayed animals the end-point of the reaction was indefinite: in either case the test animal must be killed

The discovery by Stockard and Papanicolaou that the particular stage of the œstrous cycle in a living guinea-pig could be easily determined by taking a smear of the vaginal contents was soon applied by Long and Evans and by Allen to the rat and mouse, and the method of following the activity of ovarian extracts by observing the appearance of œstrus after injection of the preparation under test in ovariectomised animals by means of the vaginal smear technique was quickly developed In the case of testicular extracts no such simple test is available, with the result that our knowledge of the hormones of the ovary, incomplete though it is, is in a much more advanced state than that of the secretions of the testis.

THE OVARY.

A very good review of the physiology of ovarian activity has been given by A S Parkes (*Biol Reviews*, vol 3, p 208, 1928), to which those interested in this subject may be referred. At the present time opinion generally favours the view that the ovary secretes at least three different hormones, one controls the development of the secondary sex organs, the uterus, vagina, etc, before puberty, one is responsible for the œstrous symptoms, whilst the third is secreted by the cells of the corpus luteum.

It is possible that the prepubertal growth of the secondary organs is due to the secretion of the œstrus-producing hormone, a view, however, which presupposes an abrupt change in its mode of action at puberty On the other hand, the œstrous reaction of ovariectomised animals following an injection of 'œstrin' appears incomplete, in that copulation is only infrequently observed, and in the spayed bitch the hormone only produces symptoms of pro-œstrus, so that possibly the missing factor may be the hormone responsible for the initial development of the accessory sex organs The cause of the first œstrus at puberty appears to lie outside the ovary, and recent work suggests that a hormone from the anterior lobe of the pituitary gland is concerned both in stimulating the first œstrus and maintaining the regularity of the œstrous cycle However, since injection of an extract of a young male pituitary will produce œstrus in an immature female with intact ovaries, the actual reason for the sudden development of œstrus at puberty still remains obscure

By far the greater amount of recent work has been devoted to the extraction and physiology of the œstrus-producing hormone or 'œstrin,' as Parkes and Bellerby have named it At present two widely different methods of extraction have been utilised, resulting in the production of the hormone in an oil-soluble or water-soluble state. In the first method fat solvents are used for the extraction: thus the minced ovaries may be thoroughly extracted with alcohol, the filtrates concentrated to a small bulk, again taken up in alcohol, filtered, and set aside for the separation of fats and cholesterol The filtrate is then taken to dryness, dissolved in ether and lipoids precipitated by addition of acetone (F Dickens, E C Dodds, and S Wright, *Biochem. Jour*, vol 19, p. 853, 1925). Material obtained by such a process is a brownish oil, soluble in fat solvents and thermostable: the activity remains in solution when sterols are precipitated by digitonin A dose of about 1-10 mgm is necessary to produce œstrus in 50 per cent of a series of ovariectomised rats

A variety of methods has been used to obtain the hormone in a water-soluble form Dodds has obtained it in the form of a hydrochloride by extracting minced ovaries with picric acid and acetone or minced placenta with hot hydrochloric acid and precipitating the picrate in the filtrate, the picrates being converted into hydrochlorides by solution in acid alcohol followed by precipitation of the hydrochloride by acetone the material thus obtained is of about the same activity as that extracted by the use of fat solvents More recently the same investigator has described a method for obtaining the water-soluble hormone in a purer state (H. Allan, F Dickens, E C Dodds, and F O. Howitt, *Biochem Jour.*, vol 22, p 1526; 1928) Placenta is used as source rather than ovary. it is heated with baryta and the filtrate concentrated and extracted with butyl alcohol by shaking the extract is evaporated under reduced pressure almost to dryness, and the residue dissolved in hot water and filtered; the precipitate and filtrate are both extracted with ether, the extracts washed with water and concentrated to an oily residue This is dissolved in alcohol and then suspended in water and extracted with ether, the ethereal extracts are washed with hydrochloric acid and water. After removal of the ether the residue is suspended in water and heated with baryta · the activity passes into the filtrate from which barium is removed as sulphate or carbonate The material appears to be in true (or colloidal) solution, since it is filterable and dialysable: about 0 02 mgm solid matter will produce the œstrus response on injection There is no relationship between the nitrogen content and activity of the solution. Millon's reaction is positive, but the biuret test is negative

There is an important difference between the reactions of the hormone in solution in oil and in water a single dose of an oily preparation will induce œstrus in an ovariectomised rat or mouse,

whereas a single dose of an aqueous solution may be entirely without effect a series of six injections spread over forty-eight hours will, however, in the case of an active solution, produce œstrus on the third or fourth day The necessity of multiple injections of aqueous solutions was first stressed by Laqueur and has been fully confirmed by Dodds

The œstrus-producing hormone occurs in the follicles and stroma of the ovary but is absent from true luteal tissue · it is present also in placenta, urine, and probably blood It is probably produced by the cells of the ovarian stroma, whence it finds its way to the other situations in which it is found the follicle is certainly not an essential source, since ovaries sterilised by exposure to the X-ray still produce it, animals thus sterilised passing through the cyclic changes of œstrus in a perfectly normal manner As regards its presence in the placenta, it is possible that this organ withdraws it from the circulation in order to protect the fœtuses from its influence

Œstrus supervenes after an injection of œstrin in about two days, and ovariectomy may be followed by œstrus 36-48 hours later, indicating that under natural conditions the stimulus to the vaginal reaction is already active about two days before the reaction occurs Examination of the ovaries indicates that follicular maturation occurs during the 48 hours before œstrus, that is, after the stimulus has become active ; so that both processes appear to depend on the same stimulus, and the view that the follicle is the source of the œstrous reaction becomes untenable (F W. R. Brambell and A. S Parkes, *Quart Jour Exp Physiol*, vol 18, p. 185, 1927) Injection of a large amount of œstrin has no effect on this latent period, but prolongs the period of œstrus even up to about a fortnight Ovariectomised animals are usually fat and sluggish : œstrin restores activity and reduces weight ; rats show a period of maximum activity at the time of œstrus. The work that has been carried out on the effect of ovarian extracts upon metabolism indicates that in some animals (dogs), especially after castration, the nitrogenous metabolism is increased, whilst the gaseous exchange is diminished : injection of extracts of corpora lutea has the opposite effect on the nitrogen output. In other species, for example the rabbit, little change in the metabolism has been observed following the injections (V Korenchevsky, *Brit Jour Exp Path*, vol 6, p 6, 1925). L Mirvish and L. P. Bosman have found that alcohol extracts of ovary reduce the blood calcium of rabbits and human beings of either sex after injection, the effect reaching a maximum in twenty-four hours with a return to normal in forty-eight hours (*Quart. Jour Exp Physiol*, vol 18, pp 11 and 29, 1927).

The influence of the menstrual cycle upon the mental and muscular efficiency and general functional activity of women has been investigated by S. C M. Sowton, C S. Myers, and E M Bedale (Industrial Fatigue Research Board, Report No 45; 1928) The direction of any change in efficiency at the menstrual period appears to be influenced by the social status of the subject studied, University students showing no change or a greater efficiency. As regards functional efficiency, there appears to be a periodic heightening in the late intermenstrual phase with a corresponding reduction shortly before or at the onset of menstruation Since ovulation in the human female occurs about the middle of the cycle, this result is parallel to the greater activity observed in the rat at the time of œstrus

The changes in the uterus after œstrus do not appear to depend on the presence of œstrin · in fact, prolongation of the action of œstrin hinders them, and injected during pregnancy, abortion is produced Although probably responsible for the pro-œstrous bleeding which is seen in some animals, the post-œstrous bleeding which occurs in primates appears to set in when the action of œstrin wears off Thus hæmorrhage from the genital tract has a different significance in different species F H A Marshall considers that menstruation in the human female represents a pro-œstrous and a pseudo-pregnant degeneration of the uterine mucosa telescoped into one phenomenon in other words, each cycle commences before the previous one has completely finished a similar overlap is observed in the cycles of the cow (*Quart Jour Exp Physiol*, vol 17, p 205, 1927)

In several species, for example the guinea-pig and opossum, a certain amount of mammary development occurs during œstrus and can be produced in ovariectomised animals by an injection of œstrin or by grafting an ovary into a castrated male, but such development must be distinguished from that occurring during pregnancy In general it may be stated that post-œstrous changes in the secondary sex organs depend on the influence of the corpus luteum developed by the ingrowth of cells into the ruptured Graafian follicle after ovulation, the actual degree of development of this body depending on whether the ovum has been fertilised or not, and also upon the species.

In the rat and mouse the development of the corpora lutea of ovulation is very slight, in the guinea-pig and cow more marked, whilst in the dog, ferret, and rabbit it is so considerable that the changes brought about in the accessory organs simulate those of pregnancy A sterile copulation in the rat or mouse is followed by a more prolonged development of the corpora which become functional Histological differences between corpora of ovulation and pregnancy have been described by A Ostrčil and O Bittmann (*Publ Facult Médicine*, Brno, vol 4, p 217, 1926)

The functions of the corpus luteum, so far as they are at present known, are four in number the inhibition of œstrus and ovulation, sensitisation of the uterus for reception of the fertilised ovum, the maintenance of pregnancy and the development of the mammary glands preliminary to lactation. Removal of the corpora of ovulation in animals in which they are functional results in an earlier appearance of the next œstrus, prolongation of the functional life of these bodies causes its prolonged disappearance A single body in one ovary can produce this effect, and injections of extracts are stated to inhibit ovulation in rabbits (W. P Kennedy

Quart Jour Exp Physiol, vol 15, p 103, 1925). Conversely, Parkes and Bellerby have found it possible to produce œstrus during lactation in mice by injection of œstrin, the amount required depending on the number of young suckling above two (when spontaneous œstrus may occur) The inhibition to the action of œstrin is abolished in a lactating mouse unilaterally sterilised by exposure of one ovary to the X-ray, by removal of the opposite ovary, containing the corpora lutea, indicating that the inhibition is certainly due to a secretion from these bodies

A functioning corpus luteum is associated with a sensitiveness of the uterine mucosa to stimuli, either the fertilised ovum or an artificial stimulus, resulting in the production of decidual tissue, in which the ovum, if present, can be embedded Artificial stimulation of the mucosa is without effect in animals such as the rat or mouse with a short œstrous cycle, in which the corpora of ovulation are probably functionless, but the uterus can be made sensitive by inducing pseudo-pregnancy and is also sensitive during lactation, in both of these states the life of these organs is considerably prolonged. Their influence is probably hormonic in nature, since a grafted uterus can be sensitised

The presence of a functioning corpus luteum is essential for the maintenance of pregnancy, or at any rate its greater part In unilaterally sterilised mice, removal of the ovary containing the corpora invariably resulted in abortion, whilst removal of the sterile ovary was without effect hence the presence of ovarian tissue *per se* is without influence on pregnancy, the corpus luteum being the essential organ (Parkes) In the cow the corpus can be expressed manually · its removal results in abortion within a few days (O Zallmann, *Publ. biol. Haute École Vét*, Brno, vol 1, p 255; 1922) Towards the end of pregnancy the corpora lutea atrophy; evidence has been brought forward which suggests that during pregnancy the sensitivity of the uterus towards the oxytocic principle of the posterior lobe of the pituitary gland is diminished and returns to normal when the corpora atrophy: also injection of extracts, obtained from ovaries at the end of pregnancy, stimulate the secretion of this hormone, suggesting a mechanism whereby the corpus luteum both maintains pregnancy and allows parturition at the proper time

The presence of functioning corpora lutea is associated with a degree of mammary gland development which is not observed in their absence, but it is not yet certain whether this stimulus alone suffices to bring these glands to complete lactation: it is possible that some product of conception is necessary for the final development. E Homann has suggested that the uterus plays a part in the development of the mammary glands (*Berich. Naturforsch Gesellsch Freiburg*, vol. 26, p. 289, 1926)

(To be continued)

Infra-red Spectra.[1]

By SIR ROBERT ROBERTSON, K B.E., F R S

HISTORICAL.

IN the year 1800 the elder Herschel, by placing a thermometer in the region lying beyond the visible red of the solar spectrum, gave the first experimental proof of the existence of radiation there by observing a rise in temperature of the instrument, and his son in 1840 described the existence of emission bands in the same region as shown by a discontinuous evaporation of alcohol from blackened paper placed in the same region

To illustrate action beyond the visible red of the spectrum the following experiment was made As it was impracticable to use the sun's spectrum, the beam from an arc lamp was dispersed by means of a large rock-salt prism, giving the usual spectrum visible to the eye A card on which a phosphorescent powder (calcium sulphide with nickel as impurity) was first caused to glow brightly by subjection outside the theatre to ultra-violet light from a mercury lamp and then placed in the spectrum, when the existence of radiation beyond the visible was shown by the quenching of the phosphorescence for some distance past the red

This region of the spectrum attracted much interest from the middle of last century and onwards when instruments of increasingly refined character were evolved to detect and measure effects of emission and absorption of radiation there Thus photography was tried, and Abney succeeded in penetrating the region for a short distance, which has not been exceeded by more recent workers employing special sensitisers for their plates Langley with the bolometer, Boys with the radiomicrometer, and Coblentz with the thermopile, succeeded in measuring quantitatively radiation in the infra-red, the last two instruments are the principal ones employed to-day in that region which lies nearest to the visible Still farther out, measurement of the energy in the beam dispersed by means of reflection from the polished surface of crystals gave important results in the hands of Rubens and his colleagues, while within the last year Raman by an entirely different technique, to be mentioned later, has indicated how infra-red radiations can be deduced from spectroscopic measurements in the visible spectrum

ELECTROMAGNETIC WAVES

The relationship of the infra-red region to other parts of the spectrum was illustrated by a diagram simplified from that prepared by Dr F. E Smith (see "Phases of Modern Science," 1925), in which the whole range of electromagnetic waves from γ rays to the longest radio waves, and only completed in recent years, is set forth On this diagram (Fig 1) were indicated the respective lengths of the waves from crest to crest in each region. the cosmic rays of Millikan, supposed by him to proceed from

[1] Synopsis of the Friday evening discourse delivered on Mar 1 at the Royal Institution.

the birth of atoms such as helium, oxygen, silicon, and iron, in the profound depths of space at the lowest extremes of temperature and pressure, of a wave-length of about $2 \times 10^{-8}\,\mu$ ($\mu = 0{\cdot}001$ mm), the highly penetrative γ-rays about $4 \times 10^{-6}\,\mu$, which accompany radioactive change, the X-rays about $1{\cdot}5 \times 10^{-5}\,\mu$, also penetrative of matter on account of their short wave-lengths, the ultra-violet rays, to about $0{\cdot}4\,\mu$, which promote many chemical reactions, the visible spectrum, from about $0{\cdot}4\,\mu$ to $0{\cdot}8\,\mu$, infra-red rays, from $0{\cdot}8\,\mu$ to about $23\,\mu$ (the near infra-red) or to $300\,\mu$ (the far infra-red), heat rays and short Hertzian rays to $1 \times 10^{8}\,\mu$, and then the rays used for wireless, the length of which may be measured in miles, 5XX, for example, being 1560 metres or about a mile long. It is a characteristic of all these waves, from the shortest to the longest, that they are propagated at the same speed, the speed of visible light, or 186,000 miles a second.

The clue to the properties of these waves was found by Faraday when he discovered rotation of the plane of polarisation of light in the magnetic field, a discovery of which Tyndall said "I would liken it to the Weisshorn among mountains, high, beautiful, and alone." This in turn was translated by Clerk-Maxwell into the succinct notation of mathematics, and it formed the basis of his electromagnetic theory, the foundation of modern electromechanics. Since then, the likeness in character of these electromagnetic waves has been shown by their being capable of dispersion, interference, resonance, and by many other physical properties.

As to the effects of the radiations in different parts of the spectrum, it may be said that whereas in the shorter wave-length regions comprising the γ, X-rays, and visible spectrum, these are mostly electronic, in the infra-red region the transitions are caused by changes in the oscillatory states of the atoms in the molecule or of the rotational states of the molecule itself.

QUANTITATIVE MEASUREMENT OF INFRA-RED BANDS

Dispersion by means of a grating having been referred to, a modern infra-red spectrometer of Hilger was then described as to its respective parts, the source of radiation (a Nernst filament), the slits, the reflecting mirrors, the dispersing prism (of quartz up to $3\,\mu$, fluorite up to $8\,\mu$, of rock-salt up to $17\,\mu$, or of sylvin up to $23\,\mu$), and the thermopile. Special reference was made to the thermopile, composed of bismuth-silver couples used in conjunction with a galvanometer for measuring the energy passing through the instrument. Its sensitiveness was illustrated by allowing a little compressed air to enter a sealed bell-jar containing the instrument, when by adiabatic compression of the air, the heat generated was registered by movement of a spot of light from a Moll galvanometer.

An experiment was then performed to illustrate the method of mapping an absorption band, ammonia being the gas employed. Two tubes were so arranged that they could alternately be thrown into the optical path between the source of radiation and the spectrometer, one tube being empty while the other contained ammonia gas. The energy passing through the respective tubes was measured by a galvanometer which threw a spot of light on a large scale on the wall of the theatre. At $1{\cdot}8\,\mu$ the difference between the throw of empty and gas tubes was small, but this difference increased up to $2{\cdot}2\,\mu$ and then decreased. These differences were noted and then plotted against wave-length on co-ordinates marked out on the blackboard, when a distinct band due to absorption by ammonia appeared in this region.

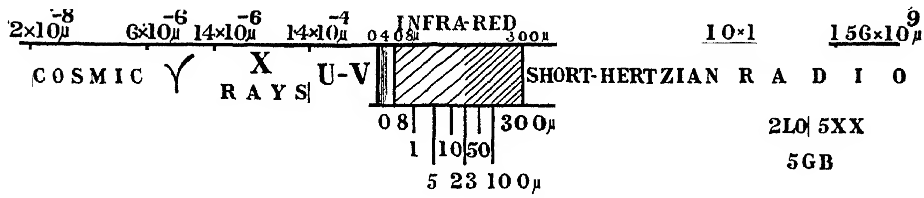

FIG 1.—Electromagnetic waves. Velocity = 30,000,000,000 cm per sec = 186,000 miles per sec.

OSCILLATION AND ROTATION BANDS

Bands due both to oscillation of the atoms in the molecule and rotation of the molecule itself are found in the infra-red spectrum. Oscillation bands were shown by Drude, from the phenomenon of dispersion in crystals, to be necessarily present, having wave-lengths such as occur in this region of the spectrum, if certain smaller charged particles (electrons) are concerned in the ultra-violet region. As the effect is one of resonance, the atoms in a molecule respond in their vibration to radiation possessing some particular frequency, and this was illustrated by a model in which a ball suspended on a spring from the end of a light rod supported on two nodes, was made to perform vertical oscillations, whereupon a ball similarly suspended at the other end of the rod picked them up and vibrated vertically in phase with the former ball. The electronic linking between the atoms prevents their oscillation being truly sinusoidal, harmonics may therefore be expected and are in fact found.

Molecules also undergo rotation, and this effect is reflected in their infra-red spectra. The main bands are due to oscillation, but in addition the rotation of the molecule also produces bands, of a simple character in the far infra-red, but in the near infra-red as fringes superimposed on the oscillation bands. Rayleigh, assuming on the basis

of classical mechanics a Maxwellian distribution of velocities, in 1892 showed that an oscillator emitting and absorbing at a frequency ν_0 due to its oscillations alone, would, when rotating about an axis perpendicular to its line of vibration with a frequency ν_r, emit and absorb at the new frequencies $\nu_0 + \nu_r$ and $\nu_0 - \nu_r$. This seemed at first to meet the case, as in some of the early bands, such as those of Burmeister, two broad areas occurred which the Maxwellian distribution of rotational velocities would require. In 1911, however, Nernst concluded that rotation must also be quantised, and in 1912 Bjerrum and E. v. Bahr resolved a band of hydrogen chloride into a series of small bands, which they ascribed to the effects of rotation of the molecule. This band has been better resolved by Imes and others, and from the spacing of the fringes the diameter of the molecule of hydrogen chloride has been calculated. Sommerfeld, applying the principle of Bohr, showed that the equal spacing of the fringes is best explained by quantising the moment of momentum, so that each quantum jump represents a change in the moment of momentum. If the moment of momentum $J\omega$ is taken as a whole multiple of $h/2\pi$, $J = mh/2\pi$ and $E_{\text{kin}} = \frac{h^2}{8\pi^2 J}m^2$, by the Bohr-Einstein conception

$$h\nu = E - E_1 = \frac{h^2}{8\pi^2 J}[m^2 - (m+1)^2] = \frac{h^2}{8\pi^2 J}(2m-1),$$

whence the space difference is $h/4\pi^2 J$, a result in accordance with facts. It will be seen that by putting the spacing difference $\Delta\nu = \frac{h}{4\pi^2 J}$, the moment of inertia of the molecule can be calculated, and, from the moment of inertia, given the masses of the vibrating atoms, the length of the molecule.

INFORMATION GIVEN BY INFRA-RED SPECTRA

In the first place, we get the frequency of oscillation of the atoms within the molecule, and the frequency of rotation of the molecule itself. These have been shown for a simple molecule such as that of hydrogen chloride. In addition, with more complicated molecules, it is possible to construct models by taking into consideration the presence of absorption bands and assuming a law of force between the atoms in the molecule. Thus Hund considers that ammonia has a tetrahedral structure, and this is probably also the case with the analogous phosphine and arsine. With these gases at least three sequences of bands have been found in each, corresponding with three degrees of freedom of oscillation, one of the sequences in each gas having five or six harmonics. In this sequence the frequency of vibration gets slower as the weight of the atoms nitrogen → phosphorus → arsenic increases in the three gases.

It is interesting from the chemical point of view to see if any of these degrees of freedom correspond to the chemical bonds of the chemists, and some hint of this is obtained in one case at least. Thus by progressively substituting the H in NH_3 by CH_3, a certain band—the first harmonic of the main sequence mentioned above—disappears from the spectrum after the last H has been substituted, so this degree of freedom of oscillation has been identified as connected with the chemical bond N-H.

Again, as regards rotation, we have found two moments of inertia in ammonia, of which one can be attributed to rotation round the median line and the other round the centre of mass at right angles to the median line. Calculation of the length of the molecule, as above described, gives a value similar to, although somewhat smaller than that obtained by Rankine from measurements of viscosity of this gas. By the comparison of spectra of related compounds, as for example in the case of hydrocarbons, definite bands have been attributed to certain groups or radicles. In the case of solids, certain groupings such as NH_4^+ or CO_3^{--} have similarly been identified in the spectrum of salts.

In the hands of Coblentz, infra-red data and technique have been used to determine the quantity of radiation from the sun, stars, and planets, and he has also deduced the temperatures which prevail in these bodies, and even the differences in radiation from the hemispheres of Mars.

The knowledge of the infra-red spectrum of water vapour and of carbon dioxide is of importance in considering the nature and quality of energy reaching us from the sun, and only recently Dr. G. C. Simpson, by making use of the absorption coefficients of water and carbon dioxide in the infra-red, has deduced that an increase in solar radiation would result in increased cloud and precipitation, and even in the apparent paradox of an ice age. Further, Paschen's determination of the emission and absorption bands of these gases is fundamental in questions relating to combustion.

FUTURE WORK IN THE INFRA-RED.

Such are some of the results that spring from the consideration of infra-red spectra. On the more theoretical side it has thrown light on and given support to the quantum theory. It has passed into the hands of the still more modern exponents of the wave mechanics and found to be in accord with their predictions, as for example in connexion with the assumption of half-quantum numbers. This is a field in which its usefulness is only beginning.

Only last year, Prof. Raman of Calcutta, by imposing monochromatic radiation from a mercury lamp on gases and liquids, observed spectroscopically in the scattered light not only the original line but also others at frequency differences which he finds are equal to frequencies in the infra-red at which bands characteristic of the gas or liquid were known. This brilliant experimental confirmation of the quantum theory may prove of the highest importance from a theoretical point of view when it comes to be explained why in the Raman effect not all the bands found in the infra-red by the usual means appear, and why others appear to be disclosed only by the Raman effect.

Like the X-rays, the infra-red deals with the

structure of the molecule, but while X-rays reveal the molecule in its static condition and are especially applicable to solids, infra-red spectra reveal the dynamic characteristics of the molecule in gases, liquids, and to a restricted degree in solids. In the future it will undoubtedly be used to a greater extent in the determination of the nature of chemical linkages and generally for a solution of problems of chemical constitution

As Garner and his school have shown, important deductions can be made as to the rôle of infra-red radiation in combustion, as for example in the effect of water, when it is present, in carrying off the energy of radiation produced when carbon monoxide combines with oxygen, and as the bulk of the radiation from flames is in the invisible part of the spectrum and mainly in the infra-red, there is here a wide field of work in clearing up the mystery of flame, and the same is true as regards the phenomena of explosion of both gaseous and solid explosives

It is to be regretted, however, that more work is not being done in Great Britain in the exploration of this region. It is true that the technique is difficult, and there have been several investigations reported of an accuracy that leaves a good deal to be desired Most of the work until now has been done in Germany and in the United States, little having so far come from British universities with the exception of Cambridge, where there is an embryonic school. The subject is perhaps scarcely one suitable for a young graduate to acquire the technique and embody a year's work in a thesis for some degree, but one for a more permanent staff, and I should like to make a plea for its greater consideration in Great Britain, as a field of experiment and study likely to assist in the solution of many physical and chemical problems, which in due course will have its reflection in the domain of technical application

Sir J. J Thomson has given us the electron, Rutherford the proton with its planetary electrons and the structure of the proton, the Braggs have elucidated the structure of many molecular fabrics, but the molecule as a dynamical entity has been comparatively neglected For it is in the infra-red region of the spectrum that this behaviour can best be studied In this aspect the problem is a physical one for the most part, the technique is difficult, but likely to be productive of much that is important in our conception of the structure of matter It is for this reason that one would like to see in Britain a strong school arise which would have as its object the study of the dynamical behaviour of the atoms in the molecule and of the molecule itself

Obituary.

PROF. WILLIAM KUSTER

DR WILLIAM KÜSTER, professor of organic chemistry and technology at the Technische Hochschule in Stuttgart died suddenly on Mar. 5 of heart failure From the pages of a recent issue of the *Chemiker-Zeitung* we glean the following details of his career.

Born at Leipzig in 1863, Kuster received his early education in Berlin and studied later at the Universities of Tubingen, Berlin, and Leipzig. At Leipzig he worked under the direction of Wislicenus, with whom he remained for a while after graduation until he was appointed assistant to Hufner at Tubingen, where he was given charge of the practical chemistry classes for medical students In 1894 he published his first paper on salts of hæmatin. This was followed by an intensive study of the pigments of blood and bile, subjects which he made peculiarly his own and remained his chief interest throughout life.

In 1903, Kuster was appointed professor of chemistry and pharmacology at the veterinary college at Stuttgart and lecturer on pharmaceutical chemistry at the Technische Hochschule. The duties attached to these offices were so burdensome that but little time was available for research. Moreover, at the veterinary college he found that no provision had been made by his predecessor for experimental work. In spite of these difficulties he succeeded during the next eleven years in publishing numerous papers on hæmatin, porphyrin, pyrrole, and bile-pigments.

On the retirement of Prof C. von Hell, the department of chemistry at the Technische Hochschule at Stuttgart was completely reorganised and Kuster was appointed to the chair of organic chemistry and technology Under his direction the department was greatly enlarged, and in spite of the difficult nature of the work in which he was engaged, he attracted a great number of research students to assist him in his investigations In this way Küster and his collaborators were able to make a large number of important contributions in the field of biochemistry Later his interest extended to other branches of natural products such as sugar, albumen, lignin, etc. He also contributed to the well-known handbooks of Abderhalden and Thoms

WE regret to announce the following deaths

Prof. Jules Cornet, the distinguished geologist and professor in the University of Ghent and at the School of Mines at Mons, *correspondant* of the Paris Academy of Sciences, who was well known for his geological explorations in the Congo in 1892 and 1895, on May 17.

Mr. Stewart Culin, curator of ethnology in the Museum of the Brooklyn Institute, Brooklyn, N.Y., known especially for his comparative studies of the games of North American Indians and other races, on April 8, aged seventy years.

Prof. Charles Deperét, professor of geology in the University of Lyons and a foreign correspondent of the Geological Society of London, on May 17, aged seventy-four years.

M. Ulysse Gayon, a distinguished biologist and chemist, and honorary doyen of the Faculty of Sciences at Bordeaux, aged eighty-three years.

News and Views.

IN the short address which he delivered at the dedication of Darwin's home to the nation on June 7 (NATURE, June 8, p. 875), Sir Arthur Keith touched upon the relationship between sentiment and science. When sentiment enters a laboratory by the back door science takes the earliest opportunity to escape by the front, yet, since life is as it is, science cannot easily be cut adrift from personality The value of such a gift as that which Mr. Buckston Browne has made to the British Association lies in the power of the personal associations of its material contents and surroundings to throw the visitor back into the very atmosphere of the century and of the place in which Darwin moved and thought. So a background of sentiment is formed which illumines and may help to interpret the development of the man's mind and the direction of his labours Down House is a memorial, not to Darwin's science, which will outlast our buildings, but to his personality It is especially appropriate, therefore, that the donor should have expressed the wishes that the house and grounds should be maintained in a state as near as possible to that in which Darwin modelled them, and that they should be used to advance the cause of science, in ways in which the Council of the British Association thinks best. "If any place can provide inspiration for research it should be Darwin's own gardens."

SIR ARTHUR KEITH's presidential address at the annual congress of the South-Eastern Union of Scientific Societies on June 5 at Brighton was singularly happy both in subject and method of treatment In demonstrating the racial characters of the pre-Roman inhabitants of Southern England, he was able to draw much of his material from discoveries on the South Downs relating to prehistoric man, and to refer to material evidence deposited in local museums Taking the skeletal remains found in the neighbourhood of Brighton, the Maycroft skeleton, the Ditchling and Blackpatch (Worthing) finds, he linked them up with the crouched burial discovered at St Catherine's, in the Isle of Wight, some three years ago. Hence by means of the identification by Mr O G. S. Crawford of a peculiar piece of pottery found in 1881 in a burial at Nunning, some ten miles from St. Catherine's and preserved in the Carisbrooke Castle Museum, he was able to relate the Brighton folk as kin to the Beaker folk who settled in Britain at the end of the neolithic and beginning of the Bronze Age some two thousand years before Christ, a relation to which the skeletal remains had pointed but for which cultural evidence indicative of a chronology had been lacking It was outside Sir Arthur Keith's purpose to trace the Beaker folk back to their origin on the continent, but he did refer to the related flint miners of Belgium, this enabling him to offer an interesting suggestion of child sacrifice as a possible explanation of the discovery of skeletons of children buried with those of adults.

IT is unnecessary now to follow Sir Arthur further, when, pointing out the gap in our knowledge of the physical characters of the inhabitants of Britain after the settlement of the Beaker folk, he turned to trace the history of the people of Southern England back through the finds which could be dated to periods immediately preceding the Roman invasion It may be noted, however, that here again he gave full weight to local investigation and also to those of Mr. and Mrs. Cunnington at All Cannings Cross and Woodhenge. In fact, throughout the whole address it was patent that he addressed a wider public than his immediate audience, and had in mind the broader aspects of the specific problems with which he was concerned His brilliantly lucid reconstruction of the racial history of prehistoric Southern England was in fact a convincing demonstration of the methods of study of prehistory and an eloquent plea for a wider recognition of the value of archæology in the reconstruction of history Sir Arthur Keith brought out, even if he did not specifically stress in every instance, the value to archæological studies of what may be termed localised research It has been mentioned that his material was largely drawn from local investigations Not only was this the case, but also it was by means of the correlation of local records and the examination of local evidence when housed in museums within reach of its original environment that this pregnant comparative study was made possible Hence Sir Arthur Keith's address should provide a stimulus to all local archæologists and all local scientific societies.

AFTER the great paroxysmal eruption of Vesuvius in 1906 there followed seven years of obstruction and comparative repose. In 1913 the conduit became open and the normal type of external activity began. Since then the crater has been steadily filling from a succession of central conelets, and at intervals in recent years there have been minor crescendos of explosive and effusive activity. By far the greatest and most spectacular of these broke out in the early hours of June 3. The outburst began with tremendous explosions and the hurling into the air of masses of incandescent material. The central conelet split and collapsed. As it fell back into the crater lava welled out and occupied the north-eastern quadrant of the crater. Prof. Malladra announced on June 3 that he considered the eruption to be one of the periodic recrudescences of activity, that it was unlikely to last more than two or three days, and that a disastrous eruption of the culminating type—such as those of 1872 and 1906—was not yet to be expected.

ON the morning of June 4 it became clear that for a minor eruption the manifestations were more than usually violent. The interior of the crater now became a lake of effervescing lava some 500 yards in diameter. The lava overflowed into the Valle dell Inferno and escaped down the outer slopes into the valley of Cuppaccio and towards the little town of Terzigno, following the course of the 1834 lava-stream. After a short interval of quiescence from 2.30 to 7.30 P.M there was a sudden paroxysm of activity for three-quarters of an hour Incandescent matter rose

1500 feet above the crater and fell in glowing showers on the slopes of the volcano. Afterwards there were loud and frequent explosions, followed by an ash cloud that rose to still greater heights From 11 P.M. on June 5 to 3 A.M. on June 6 there were further tremors and explosions, and columns of lava were thrown into the air to break into incandescent bombs Since then there have been (at the moment of writing) no further reports of activity. The lava stream has extended five miles down the south-eastern slopes, widening to a frontage of 900 yards, destroying 110 acres of cultivated land and wiping out three small hamlets. Although Terzigno was evacuated with the prompt aid of the military, the township itself has fortunately been spared, the lava having halted 300-400 yards from the houses. It is estimated by Prof. Malladra that the volume of lava approaches half that emitted during the 1906 eruption

There is a remarkable article in the June number of the *Realist* which will arouse interest and, it may be hoped, discussion in wider circles than even the readers of this journal. It is a merciless, and on the whole well-founded analysis—most people would call it an exposure—of Wordsworth's appreciation of Nature Prof Herbert Dingle in "The Analytical Approach to Wordsworth", shows by abundant quotations what was the actual mental attitude of the poet towards the Nature which he worshipped. It was not one of questioning or of interest in the changes or process of Nature but of passive meditation and happy acquiescence in scenes and thoughts which were familiar to him. He does not seek for truth but for a mystic sublimity of feeling of which the attainment was a solemn duty of man. He never therefore particularises either in describing a person or a natural object. Cliffs are simply 'lofty' and trees 'dark', just as his human beings are distinguished not by their interesting peculiarities but by their age or their occupation, things common to a host of people.

Prof. Dingle scarcely does justice to the stimulus towards science given by the preface to the second edition of the "Lyrical Ballads" in 1800, which is one of the most admirable things in English criticism and puts the man of science and the poet in a friendly and natural relation together. Yet even in speaking of this, Prof. Dingle manages to put his finger on a weakness, or at least a limitation, of Wordsworth's attitude. The poet when speaking of the labours of the man of science regards him as isolated from the poet: it is only when finished products are reached that the poet can take them up and make use of them. Just as in science Wordsworth would make use of the finished product, so in human society he tends more and more to dwell on the past. His attitude is thus almost completely static, as Shelley's by his burning forward vision and exuberant imagination becomes vague and unreal. The whole question is of extraordinary interest and it is much to be hoped that critics interested both in science and poetry will take it up. Sully Prudhomme raised the same point in France about a hundred years later and lamented how little influence the strides of science had exercised on the inspiration of poets in the interval. Perhaps the growth in mass and specialism of science makes contact all the more difficult what Prof. Dingle makes us desire is a greater community of spirit.

In *Engineering* for May 31 is an illustrated account of the famous Carl Zeiss Optical Works at Jena, which owe their foundation to the partnership of Carl Zeiss (1816–1888), an instrument maker, and Ernst Abbe (1840–1905) the physicist. begun in 1866 At one time the works employed nearly 10,000 men and women, and in the article is a plan showing the development of the Zeiss Factory at various periods and the recent extensions The original workshops were in the town of Jena, and in 1876, by which time the 3000th microscope had been sold, the present site was purchased In the early 'eighties Otto Schott, the glass maker, became associated with Zeiss and Abbe, but the glass works, though administered by the Carl Zeiss Foundation, remains independent of the instrument factory Brief accounts are given of Abbe's contributions to mathematical optics, of the manufacture of optical glass, and of the formation and working of the Carl Zeiss Foundation, and together with these are a few details regarding the planetaria constructed by the firm, and of the Zeiss double refracting telescope sent to the Lembang Observatory, Java, and of the 650-mm. refractor finished in 1914 for the Neu Babelsburg Observatory, Potsdam.

In the same issue of *Engineering*, in a Supplement dealing with the exhibits at the North-East Coast Exhibition, Newcastle-upon-Tyne, opened by H.R.H. the Prince of Wales on May 14, is a short description of the 36-inch reflecting telescope made by Messrs. Sir Howard Grubb, Parsons & Co, for Edinburgh Observatory. Built to the specifications of Prof. Sampson, Astronomer Royal for Scotland, the telescope is mounted equatorially, three rates of motion being provided for both axes, the fastest giving one revolution in 3 minutes, while for fine setting the rate of movement is one revolution in two days and for guiding one revolution in 60 days. The optical system is that introduced by Cassegrain in 1672, the main mirror of parabolic form being 37 in. in diameter, 6 in. thick, and having a central aperture $3\frac{1}{2}$ in. in diameter. Its focal length is 15 ft. The Cassegrain mirror, near the upper end of the tube, is of hyperbolic section, 10 in. in diameter, and is designed to give an equivalent focal length of 54 ft. in conjunction with the main mirror. The instrument will be installed in Edinburgh Observatory at the close of the Exhibition.

The eighty-second annual meeting of the Palæontographical Society was held in the rooms of the Geological Society, Burlington House, on May 31, Dr. F. A. Bather, president, in the chair The annual report announced the publication at an early date of new monographs on Corallian Lamellibranchia, by Mr. W. J. Arkell, and on Cretaceous Terebratulidæ, by Dr. M. R. Sahni. It also made special reference to the death of one of its oldest members and most

valued contributors, Sir William Boyd Dawkins Mr. A J. Bull, Dr O M B. Bulman, Dr L. F Spath, and Mr. S Hazzledine Warren were elected new members of Council Dr F A Bather, Mr Robert S Herries, and Sir A Smith Woodward, were re-elected president, treasurer, and secretary respectively In a brief address, the president alluded to the numerous gaps in the series of monographs on British fossils which still existed, and made suggestions for future work

THE Medical Research Council, after consultation with the Ministry of Health and the Board of Education, has appointed the following committee to inquire into the prevalence and mode of spread of minor epidemics in residential schools, especially those believed to be spread by 'droplet infection', and to report upon the means by which they may be prevented or restricted Sir George Newman (Chairman), Dame Janet Campbell, Dr R H. Crowley, Surgeon-Comdr. S F Dudley, Dr. J A Glover, Prof M Greenwood, Mr L R Lempriere, Miss E M Newbold, Prof W W C Topley, and Mrs Joyce Wilson (Secretary)

DURING the past season the price of oysters has remained at a high level, owing mainly to the scarcity of stocks. In an article on British Oyster Fisheries published in NATURE of March 23, Dr. J. H. Orton discussed the various causes for this scarcity and indicated, in particular, the dangers of over-fishing. In this connexion it is worth while to direct attention to a "Report on a Survey of the Fal Estuary Oyster Beds" (November 1924) "With Notes on the Biology of the Oyster" (published by private subscription at Falmouth, 1926, but obtainable from the Marine Biological Association, Plymouth, price 2s. 6d), in which Dr. Orton deals with a particular depleted fishery and suggests various measures to restore it to a productive state The report is of great value to all concerned in the investigation and administration of oyster fisheries, but being privately printed it may easily escape the notice of those interested.

THE bird sanctuary at Duddingston Loch, in the Royal Park of Holyrood in Edinburgh, is making satisfactory progress, and the third Report of the Committee (Edinburgh and London · H.M Stationery Office. 6*d*. net) shows that its members are keeping close watch on the development of the area. Further planting of trees has taken place, with the object of forming a screen to keep out engine sparks from the neighbouring railway, to which was due a disastrous fire in the spring of the previous year. One of the problems of the Loch has been the remarkably few aquatic species of birds which reared young to maturity in spite of the large number of nests, and this is attributed partly to the presence of many pike in the Loch itself, and partly to the frequent attentions of some lesser black-backed gulls. An attempt was made to reduce the former by dragging the loch; the latter emphasise the danger run by any policy of wholesale and indiscriminate protection. The entomological and botanical surveys of the area inaugurated in 1927 with the view of studying the interrelations between plant and animal life have been continued, and a short note on the entomology of the sanctuary, by P H. Grimshaw, of the Royal Scottish Museum, concludes the report.

THE story of the Greenland whaling industry, in which Great Britain shared in the seventeenth and eighteenth centuries, has been traced in connexion with many of the seaports taking a major part in the 'fishery'. For the first time, however, an attempt has been made to give a consecutive account of the whaling of the port of Aberdeen, in an excellent article by James Pyper, in a recent issue of the *Scottish Naturalist* (p. 39) In 1749, for the first time, whaling vessels sailed from Scotland, and in 1752 Aberdeen entered the trade with two vessels. By 1814–17 the port stood only after Hull and London in the number of its whaling ships and its tonnage of oil Five years later London had dropped out of the first rank, and Peterhead, with 16 vessels, stood second to Hull with 40, Aberdeen, with 14, following third. In the average tonnage of oil per vessel, however, Aberdeen now stood first, the total cargoes amounting to 1225 tons It was a small return compared with the enormous catches of the present-day finner industry, but it spelt a season of prosperity for the northern seaport. The account gives a vivid notion of the ups and downs of the fishery Of the ten ships which sailed in 1830, four were lost in the ice with six of their crews, two ships returned from the fishing 'clean', one had two whales, and the remaining three, a single whale each.

THE Report for the year 1928 of the National Physical Laboratory covers 284 pages, of which 200 are devoted to detailed accounts of the work carried out in the various departments. These accounts are well illustrated and show that the Laboratory continues to maintain its position as one of the most active centres of research into questions bearing on our national industries. The projected new physics building, which has been referred to in the annual reports for many years, is now under construction so far as its central block is concerned, and the scattered rooms in the basement and other parts of Bushy House previously occupied by the Physics Department are to provide accommodation for the Electrical Standards and other departments. Work on standards of measurement has been carried on actively during the year, and with the increase of test work for the industries has diminished the time devoted to general research. The high voltage equipment is nearing completion and will enable tests up to a million volts to be made A useful addition to the report is a section of 20 pages giving precise definitions of the units and standards of measurement employed at the Laboratory.

IN his discourse on "Excavations at Ur. 1928–1929", at the Royal Institution on June 7, Mr. C. Leonard Woolley gave a short account of the final clearing of the great temple of the Moon-god Nannar, whose history was traced from the foundation of the building by king Ur-Nammu about 2300 B C. until its last restoration by Nebuchadnezzar in the sixth century B C The main part of the lecture was devoted to a

record of the continued excavation of the prehistoric cemetery. More royal tombs were found, two of which gave entirely new information as to the ritual of a king's funeral; one of these was intact, and the tomb-chamber, the stone dome over which was found unbroken, contained some remarkable gold objects. Much richer than this was a 'death-pit' containing seventy-four bodies, many of them lavishly decorated with gold, and four harps and two statues; these are among the finest objects of art yet discovered in the cemetery. Other graves produced a very large collection of funeral furniture in gold, silver, copper, stone, and clay, of which the more important were illustrated. Finally, a description was given of the work carried on at a lower level than the graves, which resulted in finding evidence of the historical character of the Flood.

IN Basel on Oct. 8–12, 1928, was held an interesting short course upon the use of electrostatic methods in biochemistry and biology, in which a group of scientific workers gathered from various centres were introduced particularly to the work of the Prague school (Prof. R. Keller, R. Furth, etc). Some of the communications given at this 'school' are published in the *Kolloidchemische Beihefte*, vol. 28, 1929 (pp. 208-390). After general introductory papers by Prof Spiro, of Basel, and Prof. Keller, papers were given upon methods of measuring electric potentials in the organism, upon the preparation of micro-electrodes, *p*H determination in living organisms, upon the use of vital staining in biology, upon dispersoid analysis by a new dialysing apparatus, etc. In all many new experimental avenues of approach to biological problems were discussed and some results obtained by these new methods briefly indicated. Many new fields of biological investigation are being actively pursued by this group of investigators, who are introducing physical methods into biochemistry and biology, and this collection of papers illustrating their outlook will be of interest to workers in widely different fields.

THE great demand for cheap electrical power for heating makes it necessary to raise the transmission voltage to the highest permissible limit, as otherwise the cost of the large amount of copper in the mains is prohibitive from the commercial point of view. Even to relatively short distances, a voltage of 132,000 is being used In Berlin quite recently an overhead line several miles in length for transmission at 100,000 volts has been erected in the suburbs of the city The question of carrying this line to the centre of the city is at present under consideration, and in all probability underground mains will be used. In Hamburg there are at present two cables, each nine miles long, working at 60,000 volts, and in Nurnberg there is an underground cable connecting two networks, which works at 110,000 volts. In the event of a fault to earth occurring on a high tension cable, a very large current will flow, and the cable will be seriously damaged for several yards on each side of the fault. An interruption of the supply will probably ensue. A method of preventing this is described in *A.E G. Progress* for April. The high voltage underground networks are connected with Petersen arc suppressors. In the event of a fault occurring these devices allow a lagging current to flow through the fault This combines with the 'capacity to earth' current at the point, making the voltage of the cable at the point practically zero and preventing a serious fault from developing. It prevents also the development of high frequency currents which arise when an arc ensues. These currents, as Duddell pointed out many years ago, may cause resonance voltages at points remote from the fault and so break down the insulation of the cable. In Great Britain and in America, steady progress is being made in the development of very high voltage cables, but we think more attention should be paid to developing devices to safeguard them when in operation.

THE Medical Research Council announces that, on behalf of the Rockefeller Foundation, it has made the following awards of travelling fellowships for the academic year 1929–30. These fellowships are awarded to graduates who have had some training in research work either in the primary sciences of medicine or in clinical medicine and surgery, and who are likely to profit by a period of work at a chosen centre in America or, in special cases, in Europe, before taking up positions for higher teaching or research in the British Isles Olive B Buckley, Dr. G. A. C. Gough, W. R. Henderson, Dr D. Hunter, G. E. Lewis, Dr. M. M Suzman, Janet M. Vaughan. Dr. Gough's fellowship is tenable at the University of Munich; the others at centres in the United States

THE condition of St. Mary's Abbey has caused concern to the Council of the Yorkshire Philosophical Society, and following upon a thorough inspection and report by H.M. Office of Works, it has been recommended that certain steps should be taken to improve the amenity of the site and to ensure the preservation of such portions as remain. The estimated cost of the work proposed is £3370.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A lecturer in economic history and economics at Armstrong College, Newcastle-upon-Tyne—The Registrar, Armstrong College, Newcastle-upon-Tyne (June 19). Two forest officers under the Forestry Commission—The Secretary, Forestry Commission, 22 Grosvenor Gardens, S W 1 (June 20). Two temporary investigators and a temporary assistant under the Department of Agriculture for Scotland, in connexion with an inquiry into the marketing of livestock and other agricultural produce in Scotland—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (June 21). A teacher of agricultural science under the Londonderry and Limavady Regional Education Committee—The Principal and Secretary, Education Office, Limavady, Co Londonderry (June 22) A Paterson research scholar in the Cardiographic Department of London Hospital—The House Governor, London Hospital, E.1 (June 22). An advisory officer in agricultural botany at the Edinburgh and East of Scotland College of Agriculture

—The Secretary, Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh (June 28) A lecturer in geography at Armstrong College, Newcastle-upon-Tyne—The Registrar, Armstrong College, Newcastle-upon-Tyne (June 28) An assistant part-time lecturer in the biology department of the Plymouth and Devonport Technical College—The Education Office, Rowe Street, Plymouth (June 29) A full-time teacher, for building trade subjects, at the Cheltenham Technical School—The Principal, Technical School, Lansdown Road, Cheltenham (June 30). Four assistant conservators in the Indian Forest Service—The Secretary, Services and General Department, India Office, S.W.1 (July 1) An assistant in geography at the London School of Economics and Political Science—The Secretary, London School of Economics, Houghton Street, W C.2 (July 1). A mining engineer under the Safety in Mines Research Board—The Under Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, Millbank, S.W 1 (July 2). An assistant or junior lecturer in the department of zoology of the University of Edinburgh, with special knowledge of invertebrates—The Secretary, the University, Edinburgh (July 5). A professor of physiology at the Medical College, Vizagapatam, Madras — The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S W.1 (July 6). A senior lecturer in biochemistry in the University of Stellenbosch, South Africa—The Registrar, University of Stellenbosch, Stellenbosch, South Africa (July 31). A lecturer in mathematics at the Gordon College, Khartoum—The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, S.W 1. A resident tutor (woman) to take geography and some education at the Edgehill Training College, Liverpool—The Principal, Edgehill Training College, Liverpool A lecturer in electrical equipment of the motor-car at the Wimbledon Technical Institute—The Principal, Technical Institute, Gladstone Road, S.W.19. A teacher of building subjects at the Croydon Polytechnic — The Principal, Croydon Polytechnic, Scarbrook Road, Croydon A lecturer in building at the Huddersfield Technical College—The Director of Education, Education Offices, Huddersfield. A male junior assistant at the Chemical Warfare Research Department of the War Office—The Chief Superintendent, Chemical Warfare Research Department, 14 Grosvenor Gardens, S.W 1. An assistant lecturer in physics at the University College of Hull — The Secretary, University College, Hull. An assistant in the mechanical engineering Laboratory of University College, London—The Secretary, University College, Gower Street, W C.1. Two male laboratory assistants in the Research Department, Woolwich, with laboratory experience in physics—The Chief Superintendent, Research Department, Woolwich, S E.18. A head of the experimental branch under the directorate of ballistics of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18.

Our Astronomical Column.

FIREBALL OF MAY 30.—A brilliant fireball was observed from several stations in Cornwall on May 30 at about 11 0 P M. G M T. Observations have, however, come in from only Lostwithiel and Bugle, and these are of somewhat rough character. The meteor gave a very brilliant flash and lit up the surroundings to such a degree that the observers found it difficult to note exact features of the path. It passed along the southern sky from west to north and was evidently from a radiant in the southern region of the heavens. Its motion was moderately slow, for it occupied 4 or 5 seconds in its flight. One of the observers, who was walking in the direction away from the object, says that he observed a great light behind him as though a brilliantly illuminated motor-car was overtaking him. It appeared like a dazzling ball of fire, but when a good view was obtained of it the nucleus looked relatively small, though surrounded by a strong glare which apparently lit up the country. Further observations are required of this interesting object, which came on the night of the general election, and on this account may have attracted notice from a greater number of observers than it would otherwise have done.

VENUS A MORNING STAR.—Venus is now a ‘ morning star ’ and will continue to precede the sun during the remainder of the present year. The planet will attain its greatest elongation on June 29, when its position will be 46° west of the sun. Its brilliancy is now declining, but not to any great extent Atmospheric conditions introduce more variations than are sometimes brought about by real differences Thus Venus will appear brighter when its computed lustre is less and when the air is very clear, than at a time when atmospheric vapours dim its light.

Venus is now approaching Jupiter, and the two planets will arrive at conjunction on July 14 at 10 A.M., when Venus will be placed about 3° S. of Jupiter. Before sunrise this pair of attractive objects may be viewed in the E.N.E. sky before sunrise, Venus rising ten minutes after midnight, and Jupiter fifty-seven minutes after midnight. If the morning sky is clear the two planets may be easily identified and their relative brightness compared.

SATURN.—The planet Saturn will reach opposition to the sun on the night following June 21. The apparent magnitude will be +0·2, and the planet will appear brighter than at an ordinary opposition because of the more favourable conditions prevailing. The rings will be widely open and the planet will be situated almost midway between aphelion and perihelion. At an unfavourable opposition, Saturn may shine as a star of +0·8 mag. only, but with attendant conditions favourable it may appear as a +0·2 mag. star It is true the aspect is by no means starlike, for the planet shines with a steady, dullish light, much in contrast with the sparkling diamond-like brilliancy of the fixed stars. At the time of Saturn's best display this year, its position will be placed on the extreme west border of Sagittarius, and as the planet is moving westwards it will shortly after enter the south region of the constellation Ophiuchus, and be visible to the north-east of the star 44 Ophiuchi. For critical observation the planet cannot be considered in a good position, its declination being 22° south, and its altitude, when passing the meridian, not greater than 16° or 17° to observers in the south of England.

Research Items.

Inheritance Fees.—In *Man* for May, Mr. J. P. Driberg directs attention to an element in primitive marriage which appears to have escaped general observation, namely, the inheritance fees or dues paid by an inheritor of a widow to the responsible members of her family. Such a fee has been found to be compulsory among three unrelated peoples,—the Lango of Uganda, and the Dedinga and Bari of the Sudan. Among the Lango a widow is normally inherited by a brother of the deceased or by his sister's son, in either case a bull being payable to the woman's family. She is differentiated from the wives by being called an inherited wife. Among the Dedinga the deceased's brother pays the fee and calls the children his own, but if a sister's son or mother's sister's son inherits the widow the son pays the fee and claims any children of the new marriage. Among the Bari, when a sister's son inherits, the fee is paid from the estate and the children belong to the estate. This seems an anomalous custom, as the bride's family had already received the full price from the original husband. It arises from an intention of making clear the economic and social status of the children of the new marriage. Marriage is not regarded as completed until the birth of the first child. The bride may not be called a wife till then. Sometimes she only lives in the bachelor's hut until the child is born. In the case of a divorce the bride price is returned and the children go with the mother; but the father, even after years, may recover the children on payment of the "heifer of upkeep" to the family of the girl or her new husband. Among the Bari, if a marriage takes place without payment of the bride price, the wife's family take all the bride price paid at the marriage of the first daughter of the union. If there is no daughter the family keeps a son until he is ransomed.

The Shishak Migrations.—Sir Flinders Petrie in *Ancient Egypt*, Pt. 4, 1928, states that the excavations at Gerar (Palestine) have produced repeated evidence of a movement from Central Asia to the west at about 950 B.C. Pottery models of square waggons with divisions from front to back and with two types of pottery wheels, one smooth, the other knobbed, are found. Similar waggons come from Anau, and knobbed wheels occur in the treasure of the Oxus, from 300 miles farther east. The latter wheel is designed to prevent sinking in sand and belongs to desert dwellers. Two types of bronze arrowhead come from Central Asia, one with a tang similar to a type found at Tomsk; the other is the triangular bladed arrowhead of Minussinsk, Altai, Perm, Siberia, and south-west Caspian. The broad-bladed iron dagger belongs to Anau, the Caspian, and Caucasus. Lastly, all the pottery figures of oxen are humped, a central Caspian type not found west of Mesopotamia. This movement, dated at 970 B.C., links with Sheshenq, the 'Man of Susa' entering Egypt. Shushinak is the national deity of Elam, worshipped at Susa, and was also a great deity among the Persians. The attribution of Libyan descent to Sheshenq is due to a misreading of the genealogy of Horpasen. His name labels his origin plainly. Further, owing to the practice of hepatoscopy, a Babylonian connexion has been suggested for the Etruscans. Now the horned head-dress of divination, the vases of offerings in Etruscan tombs in the shape of a cone with two globes over it, and other evidence point to a middle Asian origin for the Etruscans, and, it is suggested, link them up with the westward movement of Turkomans, of which evidence is found at Gerar, and of which the coming of Sheshanq to Egypt formed part.

The Extermination of the Heath Hen.—The heath hen of America (*Tympanuchus cupido*), a near relative of the prairie hen which abounds on the prairies of the Mississippi valley, provides one of those problems of casual extermination which man seems powerless to stay. Fifty years ago the heath hen was a common bird on the island of Martha's Vineyard, to which it was confined. But about fifteen years since its numbers were reduced with remarkable suddenness. Attention was directed to the danger and thousands of dollars were spent in an effort to protect the birds. We now learn from a *Daily Science News Bulletin*, issued by Science Service, Washington, D.C., that even so late as 1916 there still survived about 1000 heath hens on the island reservation, and fears of their extinction were allayed. Then, just at the time when the hens were sitting on their eggs, a disastrous forest fire swept over the area, causing the loss of the year's brood as well as of many of the females. It is said that the inbreeding of the few surviving birds weakened the stock, which became subject to some of the common poultry diseases. Two years ago ornithologists were able to find only 30 specimens on the island; in a year the number was reduced to nine, a little later to three, and then to two. Now only a single specimen is known to exist—the heath hen of Martha's Vineyard is virtually extinct.

An Alleged Anthropoid Ape existing in America.—A discovery of extraordinary interest is that recorded by Dr. George Montandon in *La Nature* of May 11, where he describes from a photograph, which is reproduced, a supposed anthropoid ape from South America. A pair of the apes was seen by M. François de Loys in the virgin forests on the borders of Colombia and Venezuela, and the female was killed. It measured about 1·6 m. in height, and, as the photograph shows, had a distinctly human appearance. Moreover, the beast had no tail, and its teeth are said to have numbered 32, although, most unfortunately, the skull was afterwards damaged during the expedition and was eventually lost. On the strength of these characters, and particularly of its size and appearance, Montandon regards the creature as a new anthropoid ape related to the gibbons, but bearing a resemblance in its coat and in the proportions of its limbs to the orang-utan. Accordingly he names it *Ameranthropoides loysi*, after its discoverer, and makes use of its presence in America to support his theory of the parallel development of anthropoids in America, Asia, and Africa. On the whole, in view of the scanty evidence, we prefer the caution of Prof. L. Joleaud, who in a subsequent paper in the same number of *La Nature* suggests that the new monkey is probably not a true anthropoid ape, but a specialised relative of the spider monkeys (*Ateles*).

Anatomy of a Fœtal African Elephant.—Dr. N. B. Eales (*Trans. Roy. Soc. Edin.*, vol. 56, Pt. I, 1929) completes her study of the African elephant based on the examination of a well-grown fœtus. Previous parts dealt with the anatomy of the head and with the body muscles. The final part deals with the remainder of the organs. The most interesting feature in the anatomy of the elephant is the reduction of the pleural cavities shortly after birth by the ingrowth of trabecular connective tissue from the thickened costal and dorsal pleura. The result of the obliteration of the pleural cavities is to reduce costal movements during breathing to a

minimum and to make respiration in the elephant largely diaphragmal. The elastic tissue helps to control the powerful diaphragmatic movements so that the air is not sucked too violently through the long nasal tubes The diminution of the collapsing power of the lungs consequent on their adherence to the walls of the chest has rendered intra-pulmonary cartilages unnecessary. In the light of her investigations, Dr. Eales discusses the relationships of the two living species of the Proboscidea, and the affinities of the group as a whole. She agrees with the view of the palæontologists that the African and Indian elephants should be placed in two distinct genera, *Elephas* (Indian) and *Loxodonta* (African). The characters of the two genera are summarised and the view adopted that they belong to different lines of descent. Discussing the affinities of the Proboscidea as a whole, Dr Eales shows that their characters bear evidence of affinities with the stock from which sprang the rodents, Sirenia, Hyracoidea, and the primates, and that their nearest relatives are the Sirenia and the Hyracoidea. The Ungulates are not near them in descent. She therefore supports the modern view that the Proboscidea should be elevated to the rank of order and removed altogether from the Ungulata.

RECLAMATION OF MOSS LAND.—Although much work on reclamation of moss land has been done, the essential principles of the treatment have never been properly established Some experiments, described by J. Gillies (*Scottish Journal of Agriculture*, **12**, p. 126), have recently been carried out on a large tract of this type of land in Dumfriesshire, and some fundamental results obtained. Before any reclamation by manurial or other treatment can be attempted, effective drainage is essential. Dung was the best type of manure for the purpose, but it would be difficult to obtain in sufficiently large quantity for work on a large scale. Gradual improvement might, however, be secured by grazing stock introduced at intervals from fertile land For correcting acidity, various forms of lime are suitable, but they all proved of little value unless phosphate was also supplied . the commercial grades of basic slag, mineral phosphate, and superphosphate are the types of phosphatic fertiliser most likely to prove of economic value. Potash and quick-acting nitrogen, on the other hand, produced no visible improvement. Direct seeding with grass and clovers in July yielded very good results if manures were supplied, particularly where dung could be given Germination, however, failed completely on untreated moss or where lime only was added Care was necessary to avoid overshadowing of the introduced species by the natural moss in the early stages of growth, tramping by stock or any other method which tended to consolidate the surface being very beneficial Red and white clovers, cocksfoot, Italian and perennial rye grass, tall and meadow fescues all germinated freely and were easily established. Rose bay willow herb is a serious trouble in any reclamation work, and if strong measures are not taken to suppress it, the moss land may merely change to an equally valueless tract of willow herb.

HYBRIDISATION OF THE MOLLUSK *CERION*.—Dr Paul Bartsch, Curator of Mollusks in the U.S. National Museum, has for some years experimented in hybridisation with various species of *Cerion*. In August 1928, whilst visiting the Tortugas Laboratory, he examined his enclosures in which had been placed young individuals of *Cerion viaregis* and *Cerion incanum* and succeeded in finding one adult which he claims to be a perfect hybrid (Year Book No 27 of the Carnegie Institution of Washington, 1928). Criticism was expressed after the original crossing experiments, because Dr. Bartsch had employed large groups (500 individuals), and it was suggested that the organisms claimed to be crosses were possibly mutations of one of the two species involved. To settle this point, restricted areas (cages or islands) were used, one virgin individual of each of the two species being placed in each isolated area There was a large mortality, but in one cage the adult hybrid was found. This is identical with those assumed to be hybrids in the mass experiments; a result which was to be expected, as in no colony of *C. viaregis* nor *C. incanum* has any individual appeared comparable in appearance to the hybrids in question It is to be hoped that more of these interesting forms will be forthcoming

THE BREAD FRUIT OF TAHITI —It is unusual in a modern botanical monograph to find a description of thirty-two varieties of a plant species which contains no scientific names The bread fruit is usually regarded as a cultivated form of *Artocarpus incisa*, but according to Raoul the name 'bread fruit' should not be attached to the wild tree of Malaysia with fertile seeds described by Linnæus with this Latin name, but should be restricted to the cultivated tree of Oceania, for which no other Latin name is at present available. Gerrit Parmile Wilder describes thirty-two varieties of this tree found growing in Tahiti and Moorea, the fruit and foliage of each variety being illustrated by photographs, in *Bulletin* 50, of the Bernice P. Bishop Museum. One of these varieties, 'Huera', produces true seeds, but all are propagated vegetatively, usually by root cuttings This monograph describes fully the native method of preparing the fruit for the table, and the value assigned by the natives to the edibility of the different varieties The author makes the interesting comment that he noted no insect, fungus, or other pest upon the bread-fruit tree, which has been in cultivation on these islands long before it was first seen by Europeans in the Marquesas in 1595.

VIRUS DISEASE OF PLANTS.—Recent work in Queensland, Australia, with which Prof E J. Goddard has been associated, seems to have demonstrated beyond doubt that the economically important disease of the banana known as 'bunchy top' is a virus disease with an aphis vector. An account of further work upon this disease, with suggestions as to its control, is given in Vol 2, No. 1, of the *Journal* of the Council for Scientific and Industrial Research of the Commonwealth of Australia. Prof. Goddard has drawn upon his experience in this investigation in his presidential address to the Royal Society of Queensland, published in Vol. 40, No. 1, of the *Proceedings* of the Society He evidently inclines to the view that the virus will be found in the category of living organisms, ultra-microscopic in size, and therefore presumably forming an intermediate step between the molecular organisms of the inanimate world and the cellular organisms of the visible animals and plants. He does not deal, however, with one puzzle which this point of view presents to the investigator. If such ultra-microscopic forms of life exist, why are they not to be found leading a saprophytic or even an autotrophic existence? Until now, attempts such as have been made by Hugo Miehe (*Biolog. Centr.*, **43**; 1924) to cultivate such ultra-microscopic saprophytic organisms have failed to produce any evidence of their existence.

DIFFERENTIATION IN THE SILL OF PIGEON POINT.—A valuable study by F. F Grout of the association of anorthosite and granite with dolerite in the great 'diabase' sill of Pigeon Point, Minnesota, appears in the *Bull. Geol. Soc. America*, vol. 39, 1928, p. 555. A

chilled doleritic roof-phase intervenes in most places between the acid differentiates and the quartzite roof. Locally this phase contains abundant phenocrysts of labradorite, and these pass here and there into masses of anorthosite These light masses apparently rose in the magma at an early stage because of their lower specific gravity. Some assimilation of quartzite by the magma is indicated, but it is suggested that the granite was probably formed essentially by differentiation, with assimilation as a merely subsidiary factor. The occurrence of granite at Pigeon Point is ascribed to the unusual thickness of the sill (250-700 ft.) which allowed ample time during cooling for differentiation to occur. The composition of the average dolerite magma is such that granite could be formed from it by crystallisation, or by the separation of partially miscible fractions, in about the proportions actually found at Pigeon Point Numerical data indicate that probably much less than a quarter of the total granite was due directly or indirectly to assimilation of sediments.

TRANSMISSION OF SOUND WAVES IN THE EARTH — The solution of the problem of underground communication through earth strata would be of great value to miners. Unfortunately, its solution offers great difficulties. The ideal method should enable miners to communicate no matter the nature of the strata, whether they are water bearing or not, and also whether they are broken up by old workings. The apparatus must be cheap, light, and able to withstand rough usage. A large number of experiments have been undertaken by the United States Bureau of Mines to find out the best way of communicating between miners entombed by a disaster and persons on the surface As many of the bituminous coal mines in America are comparatively shallow, even a partial solution would be of value to them. In *Technical Paper*, No. 433, of the Bureau of Mines, experiments on communication by L. C. Ilsley, H. B. Freeman, and D. H Nellers are described. Owing to the great developments taking place in radio, it was hoped that by this means communication could be established. The tests were made at the Bureau's experimental mine in Pennsylvania. Vertical antennæ were found to give the best results, but on the whole radio methods were found to be of little practical value. A promising method discovered was to connect the source of electrical energy (two dry cells) between a point on one side and a point on the other side of the coal seam. Some of the paths of current flow spread out to the surface and could be picked up by a telephone satisfactorily by choosing suitable earths. It was found, however, that this 'roof-to-rail' method was only practicable for the transmission of signals from the surface into the mine and was therefore only a half solution. Tests made with a geophone—an instrument which converts the earth waves made by hammering on the rock into an air wave which is heard in the ear as sound—gave good results. The simplicity of this method and of the requisite apparatus is greatly in its favour.

TEXTILES AS INSULATORS.—The usefulness of industrial research is well shown in an article by A. C. Walker on "Textiles as Insulators", which appears in the *Bell Laboratories Record* for April. Silk has been used for many years for insulating conductors owing to its much higher insulation resistance than cheaper fibrous materials like cotton. The fact that the insulation resistance of textiles is greatly diminished when moisture is absorbed, suggested that a research on the effect of moisture on textiles might discover methods of treating them which would improve their electrical properties. It was found that the continued application of voltage sometimes increased the insulation resistance a hundredfold. This was traced to the partial removal of electrolytic impurities. The most significant evidence of the importance of electrolytic impurities in silk, wool, cotton, and other textiles is the great improvement in their electrical qualities due to thorough washing with water. It was found that cotton washed with water from Lake Michigan had higher insulation resistance than cotton washed with distilled water in the laboratory. A saturated solution of magnesium carbonate was then used with encouraging results. Washing the cotton with a little calcium sulphate in it gave as satisfactory results as using water from the lake. As a result of the research the insulation resistance of cotton can now be improved by simple washing processes to such an extent that its use as a substitute for unwashed silk for telephone cords has been approved. It is estimated that for this purpose alone the annual saving effected in manufacturing costs to the Bell Company is about one hundred thousand pounds.

EFFECT OF DRYING ON THE PROPERTIES OF BENZENE.—The effect of intensive drying on the physical properties of benzene has been re-investigated by Briscoe, Peel, and Robinson, whose results are described in the *Journal of the Chemical Society* for March. Baker's previous conclusion that the density of benzene does not change upon drying has been confirmed, not only for the liquid as a whole but also for the various fractions obtainable by distillation. After drying for sixteen months, there did not appear to be any definite change in the surface tension, and any change that may have taken place would seem to be in the direction of a decrease. Baker, however, found a considerable increase after a year's drying, and attributed it to a change in the degree of association. The reason for this discrepancy is not apparent and the experiments are being continued.

CHEMICAL APPARATUS.—Messrs Griffin and Tatlock, Ltd., have issued their new catalogue of chemical apparatus, No. 12A, as an attractive and well-illustrated volume of close on a thousand pages. The firm, which combines the former businesses of J. J. Griffin and Sons, Ltd., and Baird and Tatlock, Ltd., is established in London, Glasgow, Manchester, Edinburgh, and Liverpool. The volume is divided into 12 sections, which are further classified for convenience in the list of contents. The usual fittings and furniture of chemistry laboratories are illustrated not only with pictures but also with model plans and sections. A special feature of the Balance Section is the Christian Becker chainomatic balance, the action of which is fully described. In the section for physical chemistry will be found apparatus for measuring osmosis, surface-tension, etc., and also pyrometers and various kinds of electrical appliances A section on micro-analysis opens with references to standard works where complete descriptions of methods of work will be found The apparatus is specially designed for the methods of Pregl and Dubský. A large selection of the well-known Reichert microscopes is minutely described in the optical section, which also includes refractometers, spectrometers and polarimeters with various accessories, as well as optical benches, mercury vapour lamps, selenium cells, etc., and the Bausch and Lomb projection apparatus for which the firm acts as sole agent. Meteorological appliances, laboratory machinery, and apparatus designed for the special methods of assaying used in many different industrial processes form a prominent feature of the catalogue. At the end there is a fairly long list of chemical and technical books and of Kahlbaum's pure chemicals.

Systematic Investigation of the Oceans.

AN international oceanographic conference was held in May 1928 in Berlin to commemorate the centenary of the Gesellschaft fur Erdkunde, which has published a series of papers dealing with recent and imminent expeditions.[1] Most of these naturally deal with the results obtained by the *Meteor*, but articles also describe the work of the *Carnegie*, of the little Norwegian auxiliary ketch *Armauer Hansen* in the north-east Atlantic, and the aims of the new Dutch Expedition to the East Indies in the *Willebrord Snellius*.

As these articles are for the most part summaries of methods used and results achieved, they cannot be condensed into a short review, but the following notes on various points in this symposium may be of general interest.

Numerous samples of sea-water collected by the *Meteor* in the Atlantic were analysed for gold by the method due to Haber, whereby the gold in the water is adsorbed on a precipitate of lead sulphide which on heating with lead formate and boric acid leaves a minute bead of gold. This is picked out from the crucible and measured under the microscope.

An ingenious method was used to collect the small amount of lead sulphide, about 40 milligrams in each litre of sea-water. The full flask was inverted over a crucible also containing water and the whole spun in a centrifuge, when the lead sulphide collected at the bottom of the crucible To prevent loss of water in handling, the top of the crucible was covered with a rubber cap.

The plankton rich upper layers were found to be richer in gold than the water below, much of this being adsorbed on, or contained in, the organisms. The quantity varied from about $\frac{1}{100}$th milligram of gold per cubic metre to a third of this amount, or less in the deep water.

The greater part of the scientific work of the *Meteor* centred around depth and physical measurements, from which to deduce the oceanic circulation from the internal field of force produced by differences in density, from the general distribution of salinity, and from direct-current measurements. For the first time these were successfully made from a ship at anchor in mid-Atlantic where the depth was over 4 kilometres. For this purpose stocked anchors weighing a quarter of a ton and a tapered wire cable $7\frac{1}{2}$ kilometres long were carried. The circumference of the wire cable at the anchor end was 3 6 cm. and at the end made fast to the winch 5 cm.

The temperature measurements at various depths were made with reversing thermometers, every precaution being taken to attain the greatest possible accuracy. In order to avoid error in reading due to parallax—a matter of very real difficulty on board a small ship in rough weather—the thermometer tubes were ground semicircular in section, with the bores close to the flat face upon which the graduations were marked. The readings were carried to the third place of decimals, the graduation being in 0 05°.

Only general conclusions regarding circulation in the Atlantic have yet been published; the mass of data and calculation for the application of Bjerknes' theory is in process of being worked up.

An account of the biological survey by E. Hentschel includes a chart showing the number of plankton organisms present per litre of surface water (Fig. 1).

The effect of water rising from below and bringing nutrient salts to the upper layers, where there is sufficient light for plant growth, is clearly shown along the west coast of Africa. The same effect is also shown in lower latitudes due to convection currents and unrestrained turbulent motion unchecked by a discontinuity layer.

The chemical observations by H Wattenberg are of particular interest. The distribution of phosphates and nitrates and the relation of these nutrient salts to the density of plankton in the south Atlantic confirm and extend previous investigations in more limited areas. The distribution of dissolved oxygen was found to be regular and to reflect the circulation in the deep water, saturated cold water falling in high alti-

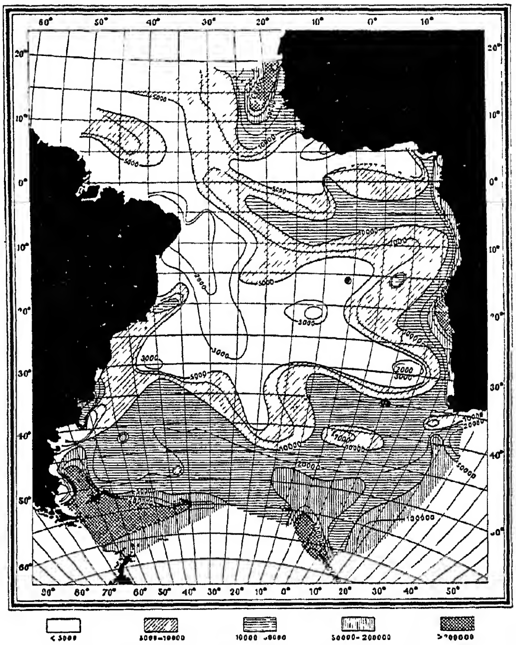

FIG 1—Plankton content of the surface-water of the Atlantic, showing number of organisms per litre of water. From "Verhandlung der ozeanographischen Konferenz"

tudes and filling the depths of the oceans, overlaid by water layers of less oxygen content in lower latitudes. The minimum occurs at about 200 metres in the tropics, where a relatively thin warm and light layer lies like oil on the heavier water below; mixing by convection is hindered, and the supply of oxygen is cut off from above. This minimum layer appears to be the graveyard of plankton organisms where oxygen is used up during their decay. The presence of 5 to 6 c.c. of oxygen per litre in the deep water of the oceans indicates its origin in those latitudes where the surface water is at a temperature where more oxygen is needed for saturation, and where in winter convection currents can extend deep into the sea.

The distribution of dissolved calcium carbonate in the sea is peculiar. In the upper water layers of the tropics values indicating 50 per cent over-saturation are indicated; below this the main mass of water is under-saturated; less so near the bottom, where calcium carbonate is apparently dissolving out from the calcareous skeletons of dead organisms. The actual quantity of calcium in solution, however, is considerably less in the upper layers, where it is utilised to build up the skeletons of such organisms.

[1] "Verhandlungen der ozeanographischen Konferenz veranstaltet von der Gesellschaft fur Erdkunde zu Berlin anlasslich ihrer Hundertjahrfeier." Berlin, 1928.

Closed Carbon Chains in Organic Chemistry.

PROF. W. H. PERKIN chose "The Early History of the Synthesis of Closed Carbon Chains" as the subject of the first Pedler lecture, which he delivered before the Chemical Society on May 30 It was, he said, very difficult to appreciate the fact that not more than fifty years ago the idea was firmly fixed in the minds of chemists that organic compounds must be sharply divided into the group having open carbon chains and the group having six-membered rings The lecturer gave an interesting account of his discussions, as a young student, with Victor Meyer and Baeyer regarding the possibility of preparing compounds containing rings composed of three, four, or five carbon atoms, and of his resolve to prosecute researches in that direction.

The first step consisted in the condensation of trimethylene bromide with the sodium derivative of acetoacetic ester, followed by hydrolysis, whereby a product then believed to be acetyltetramethylenecarboxylic acid, but afterwards shown to be methyldehydrohexonecarboxylic acid, was obtained Before the erroneous interpretation had been corrected, however, the new method was vigorously developed in various directions, a substance which, indeed, proved to be tetramethylenecarboxylic acid being obtained in 1883 by the action of trimethylene bromide on the sodium derivative of malonic acid, followed by hydrolysis and elimination of carbon dioxide.

Two years previously, Markownikoff and Krestownikoff had obtained an acid which the lecturer and E. Haworth afterwards proved to be *trans*-tetramethylene-1:3-dicarboxylic acid; it was remarkable that this earlier observation attracted little attention at the time, and remained undeveloped. Experiments on the action of ethylene bromide in place of trimethylene bromide on the sodium derivatives of acetoacetic ester and malonic ester brought the lecturer into conflict with Fittig, who with his pupils was at that time investigating the conditions of formation and the properties of lactones. Prof. Perkin gave a brief account of the evidence which led to the recognition of the formation of acids derived from trimethylene.

The next step was to devise a method for the preparation of a derivative of the five-carbon ring. Tetramethylene bromide was then unknown, but ten years later it was obtained accidentally during the preparation of pentamethylene bromide; on condensation with the sodium derivative of malonic ester it readily yielded pentamethylenedicarboxylic ester, this on hydrolysis and elimination of carbon dioxide affording the long-sought pentamethylenecarboxylic acid Similarly, hexamethylenecarboxylic acid was synthesised from pentamethylene bromide, and was shown to be identical with hexahydrobenzoic acid resulting from the reduction of benzoic acid. In the meantime, an alternative method for the synthesis of the five-carbon ring had been devised in 1885; the disodium derivative of pentanetetracarboxylic ester was treated with bromine, the resulting pentamethylenetetracarboxylic ester then affording pentamethylene-1:2-dicarboxylic acid The demonstration of the stability of the five-carbon ring confirmed the views which Baeyer had, but a few months previously, developed in his "Spannungstheorie".

Finally, the lecturer referred to the syntheses of hydrindene and tetrahydronaphthalene, published conjointly with Baeyer in 1884. Interaction between *o*-xylylene bromide (which proved troublesome on account of its severe effect on the eyes) and malonic ester proceeded exactly as Baeyer predicted

The Fauna of Scotland during the Ice Age.

IN his recently published presidential address to the Royal Physical Society of Edinburgh (*Proc*, vol. 21, Part 4, February 1929), Dr James Ritchie discussed the Ice Age in Scotland in its faunistic bearings. While Scotland must have shared in some degree the fluctuations of climate which have left traces so marked on the neighbouring shores of continental Europe, the earlier fluctuations either left no material remains or these have been removed by subsequent glaciation, for there is no faunistic evidence of the long series of changes which represents the early ice age or *altdiluvium* of continental geologists. The Scottish Ice Age exhibits but a relatively short section of the Pleistocene glacial epoch.

The remains of early glacial animals in Scotland are extraordinarily scanty, but they belong to the most important of all the animals as indicators of the period of their sojourn—the mammoth, the woolly rhinoceros, and the reindeer. The association of these three animals indicates a period corresponding to the Third Terrace of the Thames Valley. The mammoth and reindeer remains of Kilmaurs were overlaid by an extensive deposit of boulder clay, indicating conditions of ice-covered land in which even such sub-arctic animals could not have survived. Their appearance in Scotland therefore must date to a preceding warmer period which was followed by a major glaciation.

The known distribution of the mammoth in Scotland extends from Berwickshire through Midlothian to Lanarkshire and Ayrshire. Northward migration of the mammoth may have been prevented by a water barrier formed by the junction of the estuaries of the Forth and Clyde. Such a condition in the midland valley would be accounted for by a relatively slight subsidence of the land. Representative animals of the later glacial faunas have been found in Scotland only in isolated spots, with the exception of the fairly extensive faunas first discovered by Drs. Peach and Horne in limestone caves near Inchnadamph, now being further explored by Dr. Ritchie, Mr. J. E. Cree, and Mr. J G. Callander.

The oldest fauna so far discovered appeared after the cave-riddled hill, more than 1000 feet above sea-level, had been set free from an ice-cap which left enormous deposits of silt in the inner cave, and is an arctic fauna containing scarce remains of reindeer, many arctic rodents, the arctic wolf, lynx, and a very large bear. A considerable period must have elapsed before the second fauna made its appearance, when the animal remains became involved in streams flowing off the valley glacier: this fauna was predominatingly a reindeer fauna, remains of more than 400 individual reindeer having been discovered in a single cave of relatively small size. There is no trace here of modern Scottish animals. These appear in a higher layer which contains for the first time remains of red deer and, on account of the skeletal character and mode of burial of human remains in it, may be regarded as belonging to the period of Azilian culture, between the Palæolithic and Neolithic

University and Educational Intelligence.

Birmingham.—The Mason chair of botany, made vacant by the death of Prof. R. H. Yapp, has been filled by the appointment of Prof. Walter Stiles, professor of botany in the University of Reading. Prof. Stiles is well known for his work in plant physiology and on the cold storage of food. He has made numerous contributions to knowledge of cell permeability and photosynthesis.

Cambridge.—J. C. Burkill, Peterhouse, and P. A. M. Dirac, St. John's, have been appointed university lecturers in mathematics.

G. Anrep has been reappointed university lecturer in physiology, and H. Banister lecturer in experimental psychology.

R. A. Webb has been reappointed demonstrator in pathology and H. E. Tunnicliffe demonstrator in physiology.

The Council of the Senate recommends the adoption of the following regulations for the A. W. Scott fund.

I. The money received from the bequest of Prof. A. W. Scott for the furtherance of physical science shall be separately invested and shall constitute a fund called the A. W. Scott fund.

II. The income of the fund shall be applied as follows:

1. A short course of annual lectures shall be instituted in the physics department, and a sum of £100 shall be paid to the lecturer.

2. The head of the department may make grants, not exceeding a total of £150 in any financial year, to necessitous research students working in the Cavendish Laboratory.

3. A sum of £50 shall be retained in the fund each year, and money so accumulated may at any time be used by the head of the department in defraying the expenses of occasional small scientific conferences to be held in the laboratory.

4. The remaining income of the fund shall be paid into the departmental fund of the Cavendish Laboratory for general purposes.

The Rouse Ball studentship at Trinity College, founded for the purpose of enabling a student to study mathematics or the application of mathematics in a foreign university or school, has been awarded to W. R. Andrews.

On June 4 honorary degrees were conferred upon Sir Kynaston Studd (Lord Mayor of London), Prof. Langevin, Sir Frank Dyson (the Astronomer Royal), and Prof. Beazley.

The Appointments Committee of the Faculty of Agriculture and Forestry will shortly proceed to appoint (1) a university lecturer in agriculture to give instruction in crop husbandry, and (2) a university lecturer (Gurney lecturer) in forestry to give instruction in forest botany. Particulars may be obtained from Prof. T. B. Wood, Department of Agriculture, University of Cambridge.

Leeds.—The Senate has awarded the degree of doctor of science to Mr. J. H. Birkinshaw and Mr. A. J. V. Underwood. Mr. Birkinshaw's thesis was entitled "Studies in the bio-chemistry of micro-organisms"; Mr. Underwood submitted a series of papers under the general title of "The application of mathematical methods to some engineering problems".

London.—The degree of D.Litt. has been conferred on Dr. F. A. P. Aveling, University reader in psychology, for a Thesis entitled "The Psychological Approach to Reality".

Prof. John Coatman has been appointed as from Aug. 1, 1929, to the University Chair of Imperial Economic Relations tenable at the London School of Economics.

Calendar of Patent Records.

June 17, 1783.—John Fischer, mechanic, of London, is the first patentee of a pedometer, his patent, sealed on June 17, 1783, being for "a geometrical and pedometrical watch which not only answers the purposes of a common watch, but is also distinguished by showing on the dial every step the walker makes and by measuring the distance". A combined pedometer and watch of this type made a few years later, but not by Fischer, is in the South Kensington Museum.

June 18, 1823.—Great economy and improvement in the bleaching industry resulted from the patent granted to William Southworth for a machine to hang out wet fabric in the tenter-house and take it up when dry, the specification of which was enrolled on June 18, 1823. This was the first successful application of machinery to this purpose, and the invention was widely adopted. The life of the patent was prolonged for five years from 1837 in the name of E. Haworth.

June 18, 1849.—The Bourdon pressure gauge derives its name from Eugene Bourdon, who obtained a French patent for the instrument for fifteen years on June 18, 1849. An instrument acting on the same principle was invented about the same time by R. E. Schinz, a railway engineer of Cologne, as a gauge for locomotives, and was patented in Germany by C. J. Rahskopf, a watchmaker of Coblenz, in March of the same year. The rights in Bourdon's English patent were acquired by Messrs. Dewrance, of London.

June 20, 1801.—The lithographic printing process was patented on June 20, 1801, by Alois Senefelder, a native of Prague living in Germany. Senefelder brought the art to great perfection, and in 1818 published instructions for using it.

June 20, 1840.—Samuel Morse patented his electric telegraph system in the United States on June 20, 1840, and the first commercial telegraph was opened between Baltimore and Washington in 1844.

June 21, 1889.—To William Friese Greene, a London photographer, must be awarded the honour of having first introduced a practical camera capable of taking an unlimited number of photographs in rapid sequence upon a band of sensitised celluloid film and suitable for subsequent reproduction in the form of a moving picture. His patent was taken out in conjunction with Mortimer Evans and is dated June 21, 1889. The first moving picture taken by Friese Greene was that of the traffic at Hyde Park corner, and it was shown on the screen at a meeting of the Royal Photographic Society in 1890.

June 22, 1839.—On June 22, 1839, Abel Morrall, a needle-maker of Studeley, was granted a patent for burnishing the eyes of needles by threading them upon a roughened steel wire stretched in a frame and caused to revolve or to move backwards and forwards. The needles are thus made to vibrate upon the wire, and the eyes are very effectively smoothed. Up to that time there was no method of making the elongated eyes smooth, and the patent, which was acquired by Messrs. Bartlett of Redditch, became a very valuable one.

June 22, 1906.—Low-temperature carbonisation of coal and the production thereby of a smokeless fuel dates from the work of Thomas Parker, engineer, of Wolverhampton, who patented his process on June 22, 1906, and introduced the new fuel to the public under the name of "Coalite". Plants were erected at Plymouth gas works and later at Barking, but commercial success was not at that time achieved, and it has required many years of research to make coalite a marketable product.

Societies and Academies.

LONDON.

Geological Society, May 8.—F. M Trotter: The glaciation of eastern Edenside, the Alston Block, and the Carlisle Plain. Three glaciations separated by intervals have been recognised. The ice of the first or Scottish glaciation deployed from the Southern Uplands, swept across the Carlisle Plain, one stream continuing eastwards, the other advancing up Edenside, where it was joined by a stream from the Lake District. Exposures of the ground-moraine of this glaciation are rare, and in eastern Edenside the moraine is in places overlaid by a series of contorted laminated clays, etc These clays are in turn overlaid by the drifts of the second or main glaciation, when eastern Edenside was occupied by Lake-District ice and Cross-Fell ice Because of the presence of Scottish ice on the north and ice from Howgill and Wild Boar Fells on the south, Edenside became congested with ice The surface-level of the ice rose to 2200 feet at least, and probably higher. The retreat of the ice-front after the maximum of the main glaciation can be traced stage by stage The last glaciation was the renewed advance of the Scottish ice across the Carlisle plain, up to an altitude of 400 or 500 feet O.D At its maximum extension, and during its retreat, this glacier dammed up glacier-lakes which drained south-westwards —J A. Douglas: A marine Triassic fauna from eastern Persia. An account of the discovery by Mr. R. C. Jennings and Mr K. Washington Gray, geologists of the Anglo-Persian Oil Co., of a marine Triassic fauna in the district of Naiband. Comparison with other Triassic outcrops suggests an extension of the Triassic Tethys into Persia in Carnic times, and again at a later stage, in the Rhætic period. During the intervening Noric epoch, however, communication with the Mediterranean province was severed, while species characteristic of the Trias of the East Indies make their appearance in great numbers There is little evidence for migration having taken place between the two areas along the 'Himalayan route', and it is suggested that the continental barrier of Gondwanaland was breaking up into an archipelago of islands.

Royal Meteorological Society, May 15 —J. Edmund Clark, I. D. Margary, R Marshall, and C. J. P. Cave: Report on the phenological observations in the British Isles, December 1927 to November 1928. The year 1928, considered as a whole, differed but slightly from the average for 35 years. We think of the year as sunny, but the dull spring balanced brilliancy in January, July, and September; so, too, the bitter December and chilly June were offset by the wonderful warmth from January to April, with only occasional slices of cold. December checked the hazel, despite January, making it flower at the average date; coltsfoot came early. The horse-chestnut flowered two days instead of six earlier than the hawthorn. Migrants, despite some remarkable premature records of swallow, chiffchaff, and cuckoo, averaged only a couple of days early. But this fully suffices to make the lines of equal appearance dates (isophenes) shift markedly northwards compared with 1927.—D Brunt: The index of refraction of damp air, and the optical determination of lapse-rate. The correction to the index of refraction to allow for the presence of water vapour is given. Variations of humidity give results which cannot be distinguished optically from variations of temperature.—J. Reginald Ashworth: The influence of smoke and hot gases from factory chimneys on rainfall. In a manufacturing town such as Rochdale, the combustion of large quantities of coal must produce an upward current of hot air which is probably sufficient to influence the rainfall. The variation of the rate at which rain falls agrees very closely with the fluctuation of smoke emission as tested by the average number of soot particles deposited from the air each day of the week.

DUBLIN.

Royal Dublin Society, May 28 —J Joly: Bi-radiant needles for use in the radioactive treatment of tumours These needles, like those developed by the author in collaboration with Dr Walter Stevenson in 1914, are hollow, so as to contain radium or its emanation They are, however, divided vertically into half-needles differing in density or thickness so that rays issuing from opposite sides of the needle are unequally screened. It is therefore possible to control the intensity of radiation in different directions Thus the natural selective effect which is believed to be responsible for the success of radio-therapy, may be enhanced by the orientation of the needles; the surrounding healthy tissues receiving definitely weaker radiation than the body of the tumour. Details respecting security against rotational movements of the needle when *in situ*, their various forms, and mode of construction are given.—W. R. G. Atkins and H. H. Poole (1) Photo-electric measurements of illumination in relation to plant distribution Pt. 2: Using portable galvanometers and blue-sensitive vacuum sodium photo-electric cells of the Burt type measurements were made of the daylight factor (δ) at various points in a garden, δ may be as low as 1 3 per cent under laurel bushes and holly, where only ivy straggles. *Scolopendrium vulgare* may thrive with $\delta = 2\ 2$ per cent. (2) The photo-electric standardisation of an uranyl oxalate method of daylight photometry. By exposing 10 c.c. of solution in six-inch quartz tubes it was found that from 0·183 to 0·236 c c. of N/10 oxalate was destroyed per thousand metre-candles per hour The illumination was measured by a Burt cell. In noon July sunlight 85 mg oxalic acid may be destroyed per hour, and the daily variation in this rate was studied (3) The photo-chemical and photo-electric measurement of the radiation from a mercury vapour lamp. The uranyl oxalate method, the fading of methylene blue, the production of nitrite, and the Burt sodium cell were used, in conjunction with erythema tests, to measure the radiation from a quartz lamp. By means of various screens it was shown that what the cell measures may be taken as an index of the therapeutic value of the radiation. The intensity reaches a minimum one minute after the arc has struck and reaches a roughly constant value, fifteen times as great, five minutes later.

PARIS.

Academy of Sciences, May 6.—The president announced the death of Dr. Trabut, *correspondant* for the Section of Rural Economy —L. Cayeux. The conditions of the Silurian sea with Graptolites in Normandy. A study of the upper Silurian as revealed by a deep boring made at Danneville, Calvados, in a search for iron ore. The Graptolite Gothlandian of Normandy offers strong evidence in favour of a phenomenon of lagunar evaporation, leading to the formation of a bed of gypsum.—Charles Richet and Mme L. Braumann: The accelerating action of minute amounts of lanthanum salts on fermentation. The amount of acid produced by the lactic ferment is increased by amounts of lanthanum sulphate of the order of 10^{-8} grams per litre.—Gabriel Bertrand and Mlle. C. Voronca-Spirt: Titanium in phanerogam plants. Titanium is met with in all phanerogams, the

green parts, especially the leaves, containing the highest proportion of the metal Titanium has been found in plants by other workers, but its presence has been ascribed to the accidental presence of dust Precautions against such contamination have been taken —**J. B. Charcot** The South American Antarctic A statement of the results of French explorations, especially those of Dumont-d'Urville —**Léon Guillet and Michel Samsoen**: Studies of traction at high temperatures A description, with illustrations, of the arrangement of test-pieces and furnace, the latter automatically controlled within 3° of 450° C. Figures are given for the elastic limits of four steels.—**E. Mathias** · Contribution to the study of fulminating matter · its explosion by shock. Historical summary of cases of globular lightning —**Charles Nicolle, Charles Anderson, and Pierre Hornus** A new spirochæte from a case of recurrent Moroccan fever A discussion of the relations between the spirochætes of Spain, Mansouria, and the new organism, based on the agglutination effects and partial immunities.—**Constant Lurquin**: The forms of extension of the Bienaymé-Tchebycheff criterion.—**J. Favard**: What is the smallest circle in the interior of which can be put all the plane convex curves of length L and surface S ?—**Bertrand Gambier** Groups of transformation and geometrical theorems —**Georges Giraud** The generalised problem of Dirichlet, complements relating to the linear case and to the non-linear case —**A. Angelesco**. Certain polynomials of Tchebycheff —**Rolf Nevanlinna**. A problem of interpolation —**R. Chambaud** The bending of rectilinear pieces submitted to an eccentric force of compression —**D. Wolkowitsch**: A new type of spring —**P. Biquard**: The phenomena produced by the interposition of a metallic plate in a bundle of ultra-sound waves —**Henri Chaumat** · A comparison between electro-static machines and direct current dynamo machines —**Henri Gutton**. The dielectric constant of ionised gases.—**L Bouchet** The electrolytic potentials of some metals. Results of measurements of the electrolytic potential, referred to the normal calomel electrode taken as zero, are given for magnesium, zinc, hydrogen, copper, and silver.—**Mlle. A Serres**: The magnetic properties of ferric oxide and of some ferrites above their Curie point; conservation of constant paramagnetism in these combinations —**Robert Forrer**: The two Curie points, ferromagnetic and paramagnetic. To obtain spontaneous magnetisation, the existence of a magnetic moment and a spontaneous orientation is not sufficient; there must be hysteresis in addition Ferromagnetism only exists below the two Curie points.—**A. Couder** Description of the diffraction figure at the mean focus of an astigmatic bundle.—**E. Sevin**: The theories of the continuous X-spectrum and of Compton's phenomenon. Remarks on a recent communication of Décombe on the same subject —**Jean Jacques Trillat**. The phenomena of orientation and of pseudo-crystallisation resulting from the effect of traction in colloidal gels Results obtained by the application of X-ray photography to nitrocellulose or cellulose acetate films under varying amounts of stretching —**C Pawlowski**. The production of the H-disintegration rays under the α-radiation of polonium The α-rays of polonium are, as Schmidt has shown, capable of producing the disintegration of aluminium. The H_{α}-rays can be produced not only by α-rays of a path of 3·9 cm. but also by those of a path of 2·4 cm.—**E. Cornec, H. Krombach, and A. Spack** The equilibria between water and the nitrates and sulphates of sodium and potassium.—**P. Lebeau and A Damiens**: A new method of preparing fluoride of oxygen.—**Ch. Bedel** · The solubility of silicon in hydrofluoric acid The variations in the solubility of silicon in hydrofluoric acid have been attributed to the state of division of the former; the experiments detailed in the present paper do not confirm this, the most important factor in the attack being the concentration of the acid.—**Mlle. M. Cabanac**: The hydrogenation of the acetals of the fatty acids. The reaction is

$$CH_3 . CH(OR)_2 + H_2 = C_2H_5 . O . R + ROH,$$

and appears to be general. It constitutes a method of preparing either symmetrical or mixed ethers —**D Ivanoff**: The thermal decomposition of the organo-magnesium alcoholates —**Y Milon**: The existence of a marine Eocene formation in the depression of Toulven (Finistère).—**Bruet** A particular facies of the upper Pleocene of the valley of the Aujon (Haute-Marne) —**G Delamare and C. Gatti** *Indiella americana*, a hyphomycete capable of cultivation.—**Jules Amar** · The pulmonary *tirage*. This term is applied to the expression $\pi h/p$, where π is the perimeter taken round the level of the breasts, h the height of the bust, and p the weight of the body This has an average value of 124 for men and 108 for women.—**Emile F. Terroine and Mlle. Thérèse Reichert**: The influence of the salt ration on the magnitude of the nitrogen retention in the course of growth. It has been shown in an earlier communication that the presence of a complex mineral ration (common salt, potassium chloride, potassium phosphate) considerably increased nitrogen retention during growth It is now shown that the constituents of the saline mixture, taken singly, exert no favourable action —**E. Voisenet** · Divinylglycol considered as the cause of the bitter taste in the disease of bitter wine. From a sample of Burgundy attacked by the disease a liquid has been isolated with a very bitter taste It has been identified as divinylglycol, $CH_2 = CH—CH(OH)—CH(OH)—CH = CH_2$ —**Georges Blanc and J. Caminopetros** The duration of conservation of the virus of dengue in the Stegomyas The influence of the cold season in the infecting power. It has been shown that dengue is transmitted in Greece by the mosquito *Stegomya fasciata* The infected mosquitoes can live under favourable conditions at least 200 days They lose their infecting power when the mean temperature falls below 18° C, but the virus is not destroyed, since the Stegomyas again become infectious when the temperature rises above 18° C This mosquito can thus carry the infection from one year to the next.

Official Publications Received.

BRITISH

The Scientific Proceedings of the Royal Dublin Society Vol 91 (N S), No 21 The Effect of Strong Magnetic and Electric Fields on the Rectilinear Propagation of γ Rays By Dr J H J Poole and A G Clarke Pp 205-271+plate 16 (Dublin Hodges, Figgis and Co, London Williams and Norgate, Ltd) 1s

Department of Scientific and Industrial Research Building Science Abstracts Compiled by the Building Research Station and published in conjunction with the Institute of Builders Vol 2 (New Series), No 4, April Abstracts Nos 590-824 Pp v+133 171. (London. H M Stationery Office) 9d net

Indian Central Cotton Committee Technological Laboratory Bulletin No 20, Technological Series No 15 The Effect of using either One Head or Two Heads of Drawing instead of Three Heads of Drawing in the Spinning Preparation for Spinning Tests By A James Turner Pp ii+18 (Bombay) 1 rupee

FOREIGN

Smithsonian Miscellaneous Collections Vol 81, No 9 A Second Collection of Mammals from Caves near St Michel, Haiti By Gerrit S Miller, Jr (Publication 3012) Pp 30+10 plates (Washington, D C Smithsonian Institution)

Smithsonian Institution Explorations and Field Work of the Smithsonian Institution in 1928 (Publication 3011) Pp vi+198 (Washington, D C Smithsonian Institution)

Bulletin of the National Research Council No. 67 · The Minimum Protein Requirements of Cattle, Report of Committee on Animal Nutrition Pp 84 No 68 Transactions of the American Geophysical Union, Ninth Annual Meeting, April 26 and 27, 1928, Washington, D C Pp 103 (Washington, D.C National Academy of Sciences)

Diary of Societies.

FRIDAY, JUNE 14

ROYAL ASTRONOMICAL SOCIETY, at 5 —T P Bhaskaran The Number of Stars of Different Magnitude in the Hyderabad Astrographic Catalogue Fifth Paper Zone −21° —Prof. E W. Brown The Planetary Theory with the True Longitude as Independent Variable

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Annual General Meeting), at 5 —E Maddox Demonstration of the Cheiroscope —Miss M Dobson Velanoskiascopy, a Control in the Correction of Astigmatic Defects

PHYSICAL SOCIETY (at Imperial College of Science), at 5 —W E Pretty Pressure Shifts in Line Spectra of Gases —A S M Symons and J Daley The Zeeman Effect for the Arc Spectrum of Gold —Dr W Jevons The Band Spectrum of Lanthanum Monoxide —Demonstrations by G D Preston (*a*) The Crystal Structure of the Allotropes of Manganese, (*b*) The Change of Physical Properties during the Age-hardening of Aluminium Alloys

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall), at 6 —C H Faris Repairs to Diesel Engine Parts by Electro-deposition

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6

SATURDAY, JUNE 15

BIOCHEMICAL SOCIETY (at John Innes Horticultural Institution, Merton), at 11 45 A M —H W Kinnersley and R A Peters Observations on Carbohydrate Metabolism in Avitaminous Birds —E Boyland The Lag between Phosphate Esterification and Carbon Dioxide Evolution in Alcoholic Fermentation —H B Stent, V. Subramaniam, and T K Walker The Degradation of Succinic Acid by *Aspergillus niger* — R Scott-Moncrieff The Isolation and Identification of Some New Anthocyanins —E Phillis The Sugars of Tulip Bulbs —H J Channon and G A Collinson Absorption of Liquid Paraffin from the Alimentary Tract of the Rat and Pig —T Moore The Association of Vitamin A Activity with Carotene in the Carrot Root —D L Collison, E M Hume, I. Smedley-MacLean, and H H Smith The Nature of the Vitamin A Constituent of Green Leaves —H W Dudley The Isolation of Acetyl Choline from Natural Sources

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2 30 —R G Carruthers Burnt Outcrops of the High Main Coal at Newcastle-on-Tyne —*Papers open for discussion* —Roof Control on Longwall Faces, J. F C Friend, Diamond Boring Applied to Tapping Drowned Areas Underground, F E Smyth, Land Drainage, H C Pawson, The Laws of Motion of Particles in a Fluid, R G Lunnon, Boring against Workings likely to contain an Accumulation of Water or other Liquid Matter, and a Method of Negotiating a Fault, C H. Leeds, The X-Ray Analysis of Coal the Radiographic Variables and their Control, C. N Kemp

TUESDAY, JUNE 18

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Spa Hotel, Bath), at 10 A M —Dr Margaret Fishenden and A. F. Dufton Heating Research at Watford, 1928-1929 —At 2 30.—Demonstration of Treatment at the Grand Pump Room

ROYAL SOCIETY OF MEDICINE, at 5 30 —General Meeting

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E C), at 6 30 —A Capleton W H Hudson the Naturalist.

WEDNESDAY, JUNE 19

ROYAL METEOROLOGICAL SOCIETY, at 5 —Dr F J W Whipple Potential Gradient and Atmospheric Pollution the Influence of 'Summer Time'. —A J Bamford Vertical Air Currents as Measured by Pilot Balloons —Dr G Slater Studies on the Rhone Glacier, 1927 The Relationship Between the Average Air Temperature and the Rate of Melting of the Surface of the Glacier

THURSDAY, JUNE 20.

ROYAL SOCIETY, at 4 30 —Sir Charles Sherrington Some Functional Problems attaching to Convergence (David Ferrier Lecture)

CHEMICAL SOCIETY, at 8 —Prof H B Baker · Manipulation in Intensive Drying —Prof W. A Bone Notes on Intensive Drying of Gaseous Media —H J Emeleus The Light Emission from the Phosphorescent Flames of Ether, Acetaldehyde, Propionaldehyde, and *n*-hexane — A J H. Houssa, J Kenyon, and H Phillips The Relative Configuration of *d*-β-octanol and its Dextrorotatory Halides The Interconversion of the Optically Active β-octanols by a New Method

C B C SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Strand), at 8 —Mrs C B Hodson Birth Control Clinics in the United States

FRIDAY, JUNE 21

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Cambridge), at 2 — L Yates The Evolution of the Sense of Hearing —J S Tucker Localisation of Sound —S Hett, Dr A G Wells, and Dr Murray Levick Ionisation as a Treatment for Middle-ear Suppuration —At 4 30 —Dr A A Gray The Application of the Principles of Maximum Stimulation to Clinical Otology —G Wilkinson Demonstration of a Model Resonator, Designed to Illustrate the Mechanism of the Cochlea

ROYAL SANITARY INSTITUTE (at North-East Coast Exhibition, Newcastle-upon-Tyne), at 2 30 —Dr H G Davison and others Discussion on The Problem of Feeding the Premature Infant —Dr E F Murray and others Discussion on The Need for a Maternity Service —Dr H H Evers and others Discussion on The Importance of Ante-Natal Supervision —At 4 30 —D Boyd and others Discussion on Eliminating the Tuberculous Cow Administrative Results at Berwick-upon-Tweed — D W Henderson and others Discussion on Hygienic Milk Supplies —C H Westwater and others Discussion on Clean Milk in the Northern Counties —At 8 —Prof L E Hill Smoke Pollution (Public Lecture)

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Annual General Meeting) (at 11 Chandos Street, W), at 8 15 —Induction of New President, Dr G Carmichael Low —Dr J F C Haslam Some Health Problems of British Guiana —Presentation of the Manson Medal to Sir Ronald Ross, and the Chalmers Medal to Major A C Sinton

ASSOCIATION OF ECONOMIC BIOLOGISTS (Annual Field Meeting) (at Cambridge) (continued on June 22)

SATURDAY, JUNE 22

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Cambridge), at 9 30 A M —M Vlasto The Chorda Tympani Nerve in Otology —C S Hallpike Some Observations on Bone Conduction —A R Tweedie Demonstration of Apparatus for Control of Conversation Test

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (at Nottingham)

PHYSIOLOGICAL SOCIETY (at Plymouth)

PUBLIC LECTURE.

WEDNESDAY, JUNE 19

UNIVERSITY OF BIRMINGHAM, at 4 30 —Dr C Singer The Modern Spirit in Medicine (I)

CONFERENCES.

JUNE 14 AND 15

SOCIETY FOR EXPERIMENTAL BIOLOGY (at John Innes Horticultural Institution, Mostyn Road, Merton Park, S W)

Friday, June 14, at 10 A M —D Ward Cutler Soil Protozoa and Bacteria Relationships

V B Wigglesworth (*a*) The Part Played by the Tracheal System of the Tse-tse Fly during the Digestion of Blood, (*b*) The Functions of the Proventriculus in the Tse-tse Fly

Dr R A Fisher The Experimental Examination of the Theory of the Evolution of Dominance

C Diver Reverse Mutations in *Limnæa peregra*

At 2 15 —Prof A E Boycott and Dr. J Henderson Smith The Nature of Filterable Viruses

Dr R J Ludford Vital Staining with Acid and Basic Dyes

At 4 30 —Dr. M C Rayner The Practical Importance of *Mycorrhiza* to Forest Trees

A L Bennett The Changes in the Testis of the Stickleback Preceding the Breeding Season, and their Relation to the Development of Nuptial Coloration

E A Spaul The Distribution of Biological Activity in the Anterior Pituitary

Saturday, June 15, at 10 A M —J B S Haldane The Bearing of Genetics on the Species Problem.

F W Sansome Experiments on the Physiology of Pollen

E J Collins Some Hybrid Calceolarias

At 11 A M —Demonstrations —

Dr E J. Collins. Some Hybrid Calceolarias

Dr C L Huskins Cytology of Cereals and Tomatoes

M B Crane (*a*) Sterility and Incompatibility in Fruit Trees, (*b*) Graft Hybrids

T Philp Flower Colour in *Papaver*

Miss D M Cayley 'Breaking' in Tulips

Miss de Winton and Miss Pellew (*a*) Linkage in *Pisum sativum*, (*b*) Genetics in *Pisum sativum*

Miss Pellew (*a*) Genetics of *Primula Kewensis*, (*b*) Chimeras A New Segregation in W Bateson's Pelargonium, var Mrs Mappin

Miss M A Tazelaar The Effect of Rapid Limb Growth on Neighbouring Limbs in *Palæmon carcinus*

JUNE 14.

INTERNATIONAL CONFERENCE ON LARGE HIGH-TENSION SUPPLY SYSTEMS (at 9 Avenue Hoche, Paris)

In Morning —C I Budeanu Power Factor Improvement —F Rutgers · Simplified Graphical Representation of Active and Reactive Power in Vectorial Diagrams —L Gratzmuller The Conservation of Reactive Power in Electric Systems —A Iliovici Measurement of Electrical Energy and Power at Very High Voltages —G Renesson Notes on the Measurement of Electrical Energy at High Voltages — A Barbagelata Metering and Tariffs in Three-phase Supply

In Afternoon —L C Grant Lightning and Surges on High-tension Transmission Lines —R O Kapp The Selective Protection of Transmission Lines —P Traverse Investigation and Statistics on Surges in Transmission Systems —F W Peek Developments in the Control of Lightning —Barbillion and Teszner The Rôle of Condensers and Similar Devices in the Protection of Networks Against Surges Theoretical and Experimental Study —K Gotoh and Matsunaga Lightning and 154,000-volt Transmission Lines —A Iliovici Selective Protection of Networks, Based on Unbalanced Currents, Voltages, and Power —A Tchernycheff A New Method of Protection for Heavy-current Equipment —M. Walty Long-distance Communication in Electric Systems —A Tchernycheff Special Apparatus for the Protection of Long distance Communication Lines —German Telephone Administration Measurement of the Coefficient of Mutual Induction between Two Lines with an Earth Return —T N Schulz Standardisation of International Statistics in Regard to the Generation and Distribution of Electric Power —P Rieunier Interconnexion of Systems Operating at Different Frequencies —J Kopeliowitch The Use of an Ohmmeter as a Selective Relay —L Gratzmuller Increasing the Number of Phases for a Supply to Mercury Converters, with a View to Reducing the Effect of Harmonics in a Distribution System

NATURE

SATURDAY, JUNE 22, 1929.

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Editorial and Publishing Offices:

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The British Patent System.

ON a number of occasions in recent years attention has been directed in these columns to the importance of the British patent system from the point of view of scientific men, and we have pointed out that the defects from which it suffers, whether in respect of law or of administrative machinery, ought to receive more serious consideration from the Government of the day than they have until recently obtained. It has therefore been particularly gratifying to note a number of indications that the importance of this branch of the public service is coming to be recognised more adequately. One of the pleasantest of these indications was the conferment, in the birthday honours list, of a knighthood on the Comptroller-General of Patents, Mr. W. S. Jarratt, whose appointment a few years ago gave much satisfaction to those who had been contending that scientific and technical qualifications were essential to the adequate discharge of the Comptroller's duties.

The report recently issued by the British Science Guild on the subject of the reform of the patent system has received general support from the Press and from a large number of interested bodies, but perhaps the most interesting comments yet made upon it are those that have just been issued by the General Council of the Bar, which appointed, some time ago, an extremely strong committee to review the British Science Guild report. The committee included, among others, Sir Duncan Kerly, K.C. (chairman), Mr. James Whitehead, K.C., the Hon. Stafford Cripps, K.C., and Mr. Trevor Watson; the members agree that the report of the British Science Guild "is generally excellent, and that most of its proposals are reasonable and likely to be useful." They then discuss certain of its paragraphs in detail.

The committee agrees strongly that the effect of 'paper anticipations' should be restricted, that remedies against unwarranted threats should be strengthened, and that appeals from the decisions of the Comptroller of Patents should be heard by a special judge in chambers instead of by the Attorney-General or Solicitor-General as at present. The only proposals in respect of which the committee is opposed to the Guild's recommendations are those which would extend the judicial duties of the Comptroller. It thinks that the object of these proposals—namely, the mitigation of the present high cost of patent litigation—would be better achieved by (1) resort to arbitration or (2) agreement between the parties whereby the issues to be

tried in court may be narrowed down The latter of these alternatives commends itself strongly to common sense, but the former presents difficulties In a highly technical industry it is often far from easy to find an expert whose interests are entirely independent of those of the parties, and it is very much more difficult to find such an expert possessed of the additional qualification of experience in the construing of patent specifications

The recent appointment by the Board of Trade of a departmental committee, under the chairmanship of Sir Charles (formerly Lord Justice) Sargant, to consider the subjects dealt with by the British Science Guild's report, has brought the proposals for reform within the realm of practical politics These proposals have five principal aims (1) To diminish the grant of invalid patents, (2) to relieve the main patent system of the monopolies for small innovations which may be regarded as useful designs rather than inventions, and are protected in Germany by *Gebrauchsmuster*, (3) to mitigate the evils arising from the high cost of litigation, (4) to render more accessible to the public the information which is in the possession of the Patent Office; and (5) to improve in detail the efficiency of the patent system

The procedure to be adopted by the Sargant Committee has now been decided, and it appears that evidence will be received from persons having a suitable *locus standi*. It is to be hoped, therefore, that the manufacturers and others whom the subject concerns will make themselves familiar with the proposals which have been put forward, in order that a widely representative body of reasoned opinion may be available to the new committee It is gratifying to know that many organised bodies have, like the General Council of the Bar, appointed responsible committees to examine the matter from the points of view which they represent, and that at its recent meeting the Council of the British Association resolved to support the recommendations of the British Science Guild.

The growing importance of the patent system is indicated by the statistics disclosed in the Patent Office Report for 1928, which was published on May 31 last. The volume of patent business shows a rapid increase, the number of complete specifications filed during the year, namely, 24,045, being greater by 2648 than that for the previous year. The number of letters dispatched increased from 314,000 in 1927 to 331,000 in 1928, the number of patent specifications sold from 370,808 to 424,028, and the number of applications under the International Convention from 6810 to 7971 The amount received from renewal fees increased by only £5767 to a total of £283,252, but somewhat larger increases may be expected under this head as the effect of the War period passes away.

It is remarkable that during the same period the total strength of the staff increased only from 696 to 698, while the strength of the examining staff increased by only 4 to a total of 240 The staffing question is a very grave one, for not only is the work of the Patent Office dangerously in arrear, but also the utmost difficulty is likely to be experienced in obtaining any additional examiners who may be required to implement the recommendations of the Sargant Committee A competitive examination for technical posts in the Patent Office was held last year and failed to attract candidates further, the cream of the examining staff is constantly being skimmed away by the offer of more lucrative appointments in industry The problem of obtaining and keeping properly qualified recruits is one of the most urgent of those which call for early solution It is not satisfactory that officials who to-day are entrusted with highly confidential information, should to-morrow be working for rival firms in whose employment their knowledge may be embarrassing.

On the other hand, there should be no difficulty in financing considerable improvements in the machinery of the patent system without recourse to the public purse, for the annual surplus of fees over expenditure has reached the very large amount of £147,840 out of a total revenue of £544,740, and to this surplus should properly be added the cost of maintaining the Patent Office Library, which is used by the general public and cannot be regarded as the exclusive concern of patentees The following table is of interest in this connexion

Year	Complete Specifications Filed	Surplus £	Strength of Examining Staff
1924	18,800	75,202	253
1925	19,434	88,540	241
1926	19,948	98,813	238
1927	21,397	112,939	236
1928	24,045	147,840	240

On the whole, it may be said that there is a better prospect now than at any other time during the past twenty-five years of bringing the patent law and machinery up-to-date The co-operation of all who have serious contributions to make will be needed if full advantage is to be taken of the opportunity which has presented itself

The Beginnings of Entomology.

Materialien zur Geschichte der Entomologie bis Linné. Von Dr. F. S. Bodenheimer. Band 1. Pp. x + 497 + 24 Tafeln. (Berlin: W. Junk, 1928.) 2 vols., £6.

ENTOMOLOGY has been called the Cinderella of the sciences. If the study of insects has for long played the part of neglected sister among kindred pursuits, it cannot be denied that of late years it has held a position second to none in respect of its bionomic, economic, and hygienic importance. Entomological history is, however, poor in comprehensive treatises. This is remarked by Dr. Bodenheimer at the outset of the present work, which, though modestly entitled " Materials for the History of Entomology ", and stated by him to aim only at a survey, not an exhaustive presentation, is a monument of careful and industrious research, and goes far towards repairing the deficiency to which he directs attention.

The earliest entomology was utilitarian; the production of silk and of wax engaged the attention of the most ancient civilised races, to the exclusion of any matter of biological interest. According to Chinese tradition, silk cultivation, for the sake of clothing and of religious ceremonial, goes back to the Emperor Fu-hsi at the beginning of the third millennium B.C. The secret of silk production was rigidly kept throughout many ages; but within comparatively recent times illustrated works, professedly based on earlier treatises, have been issued by the Chinese, giving details of the whole process. Some interest in natural history is evinced by late editions of the Erh-ya, an encyclopædia attributed in its original form to a writer of the sixth century B.C. Recognisable figures of the dung-beetle, wood-boring larvæ, the cicada, mantis, and mole-cricket are reproduced by Dr. Bodenheimer from this work.

To the ancient Egyptians, as to the Chinese, the appeal of entomology was mainly utilitarian: though bees, and possibly wasps, appear as symbols so early as the period of the First Dynasty. A relief from the temple of Ne-user-re (about 2600 B.C.) shows the process of extracting honey from combs after fumigation, of refining, and of sealing it in a permanent receptacle. Representations of butterflies are found among Egyptian wall-paintings, some of which may almost certainly be identified as *Danaida chrysippus*. Egyptian pharmacology contains recipes in which insects take part, while the " Book of the Dead " has many references to insects. The interest taken in the scarabæus as an emblem of the sun-god is well known; it does not appear, however, that the Egyptians were acquainted with its metamorphoses. Herodotus in his book about Egypt mentions the use of mosquito curtains.

Little is known of the entomology of Assyria and Babylon, but there is a cuneiform record of the importation into Assyria and acclimatisation of bees for honey and wax; sculptures and seals of these nations present good figures of flies, and of locusts preserved for food. The inhabitants of Palestine were interested in insects chiefly for their useful, noxious, or troublesome qualities. Besides locusts, the raids of which are so vividly described by the prophet Joel, there are references in Isaiah to the ravages of the clothes moth; honey seems to have been known to the Israelites only from wild bees. In later times the Talmud contains natural history items of interest.

It is remarkable that among the earliest relics of European civilisation occurs the symbolising of the soul under the figure of Psyche, or the butterfly. A striking reproduction of a Mycenean wall-painting is given by Dr. Bodenheimer, in which the death-goddess, walking in a field of asphodel, is surrounded by fluttering butterflies. With Homer we enter upon a new period. His likening of the opposed ranks of Greeks and Trojans to swarming flies, and his similes derived from bees, wasps, cicadas, the gadfly, locusts, show powers of keen observation and poetic insight. A passage in the Iliad proves that its author was aware that maggots of carrion were the offspring of the blowfly. In Aristotle we meet the embodiment of Hellenic thoroughness; the principles of classification, the facts of anatomy, physiology, reproduction, metamorphosis, are minutely dealt with by him in relation to insects as to other forms of life. Good natural history notes are to be found in his works; and on all these accounts the philosopher of Stagira well deserves to be known as the father of scientific entomology. Among his successors, Theophrastus has valuable entomological observations, chiefly from the point of view of injury to vegetation, while Dioscorides regarded insects chiefly as ingredients in the Pharmacopœia. But the biological interest started by Aristotle was never entirely lost. His facts were incorporated in later treatises, and were amplified by Pliny, the eleventh book of whose " Natural History ", devoted to insects, shows him to have been more than a mere compiler. He, says our author, rather than Aristotle, gave the impulse to Gesner and Aldrovandi. But the sober-minded Romans generally went in for utility. The entomology of Cato, Varro, Columella was of the ' economic ' variety, and even

Virgil's poetic and imaginative "Georgic" on bees had an ultimately utilitarian object.

With the advent of the Middle Ages the Hellenic love of observation and desire for scientific knowledge underwent a temporary eclipse. Such compilations as were produced tended rather to utilitarianism or to moral teaching. But from the beginning of the twelfth century may be roughly dated a revival of interest in Aristotle, preceded by Arabic influence which began to make itself felt at an even earlier date. Aristotelian science spread into western regions, especially Spain, through Arabs who derived it from Byzantium. A translation of Aristotle's zoological works into Arabic, with a commentary, had been made about A.D. 1000; much advance had also been effected by subsequent Arabic writers. A great name of this period is that of Albertus Magnus (1193–1280), Provincial of the Dominicans and Bishop of Regensburg, whose fine treatise "De Animalibus", with its faithful following of Aristotle, gained him the title of 'Aristotle's Ape'. The book shows evidence of original observation, and contains acute remarks on the relation of structure to function. The somewhat small portion devoted to insects, like the rest, is naturally not devoid of errors; but Dr. Bodenheimer is probably right in asserting that there is no greater biologist than Albertus between Aristotle and Réaumur.

The end of the fifteenth century witnessed the dawn of a new age in art and literature. The discovery of America, the general revival of Greek, the invention of printing and the rise of vernacular literature combined to set in motion a fresh impulse towards learning in general and the cultivation of science in particular which has gone on without a break to the present day. From this time natural science gradually disentangled itself from theological and medicinal limitations. It must be admitted that in the general revival entomology lagged somewhat behind. Its new age can scarcely be said to begin until Aldrovandi published in 1602 his "De Animalibus Insectis" in seven books, the result of fifty years' study, and the first work entirely devoted to entomology. His classification, founded on Aristotle, whose influence was still strong, is in some respects less in accordance with Nature than that of his master. But he remains a true Aristotelian, though a critic of that author's mistakes. His volumes contain excellent figures, especially of Lepidoptera, and also the first illustration of insect anatomy (the silk-gland of *Bombyx mori*).

The English physician Mouffet (1530–1604) carried on and added to the compilations of Gesner and Wotton, of which he had received the drafts through Thomas Penn. Mouffet's figures of insects, which are mostly independent of Aldrovandi, are quite good. They were not published until 1634. Bacon made observations on insects, but had little or no direct influence on biological science; nor had his younger contemporary Descartes much interest in biology and its problems.

Harvey (1578–1657), who may be called with justice the founder of modern physiology, was the first of modern biologists to include invertebrates in his physiological researches. His wide conception of the 'ovum', which he took to include both larva and pupa, had the unfortunate result of leading to Swammerdam's theory of 'evolution', 'emboîtement', or preformation of the imago in the egg. Before the close of the seventeenth century Redi had disproved by experiment the theory of spontaneous generation which had held the field since Aristotle; Malpighi had published under the auspices of the Royal Society his elaborate work on the anatomy of the silkworm; and Swammerdam had executed the admirable insect dissections illustrated in his great "Bibel der Natur". A little later the pioneer microscopists Leeuwenhoek in Holland and Hooke in England had investigated and figured the compound eyes of insects, the histology of insect muscle, the structure and action of insect wings, and parthenogenesis in aphids. Goedart, a painter who took to entomology, and Lister, physician to Queen Anne, occupied themselves with the question of insect parasites. Lister was the first to establish the true life-history of the parasitic wasps.

In 1705 Madame Merian published her finely illustrated work on the insects of Surinam. A little later came Vallisnieri, who, in spite of his dictum that "Observation is better than Speculation", firmly supported Swammerdam's doctrine of 'evolution'. But the chief name for entomology at this period until the advent of Linnæus is certainly that of the versatile Réaumur, whose volumes of "Mémoires" contain most valuable studies in insect anatomy and physiology. The succession was carried on by Roesel and Bonnet; and before the end of the eighteenth century the binary system of nomenclature, towards which the previous work of Ray and Willughby had tended, was, in the hands of Linnæus, to make identification for the first time generally possible.

At this point the present instalment of Dr. Bodenheimer's exhaustive treatise is brought to a conclusion, leaving Linnæus and his successors to be dealt with in a future volume. Much commendation is due to the author for the way in which he has carried out his laborious undertaking, of which the

present article may be taken as virtually a summary The book is well produced and well illustrated The only printers' errors that have come to notice are a misplacement of reference letters on Plate VII, and "Bohart" for Bobart (the Keeper of the Botanic Garden at Oxford) on p 491

F A D

Modern Cosmogony.

(1) *Astronomy and Cosmogony* By Sir James H Jeans Second edition Pp x+428 (Cambridge At the University Press, 1929) 31*s* 6*d* net.

(2) *Eos or The Wider Aspects of Cosmogony* By Sir James Jeans (To-day and To-morrow Series) Pp 88+6 plates (London. Kegan Paul and Co, Ltd, New York E P Dutton and Co, 1928) 2*s* 6*d* net

(3) *Cosmology a Text for Colleges* By Prof J A McWilliams Pp x+243 (New York The Macmillan Co, 1928) 10*s* 6*d* net

(1) THE publication, within a few months, of a second edition of "Astronomy and Cosmogony", replete with abstruse mathematical formulæ and priced at 31*s*. 6*d*, is a noteworthy event on which Sir James Jeans may well be congratulated The demand for the book is a striking tribute to the clearness and wide appeal of the author's manner of exposition, as well as to the extent of his reputation as an authority on questions of cosmogony, for the present boom in matters astronomical, especially of the more speculative type, is by no means a sufficient explanation Naturally, within so short a time, no need has arisen for drastic alteration, although there has been more modification than the mere correction of minor errors and misprints The book has been expanded by references to various observational and theoretical results which have appeared since the first edition was written, and space has been allotted more liberally to certain problems and investigations "which", says the author, "friendly critics thought I had dismissed too briefly in the original book" We note that among the problems and investigations thus referred to are some of those mentioned in the review of the first edition which appeared in NATURE of Aug 4, 1928. The new edition contains eight pages more than the old. This is due almost entirely to additional matter, the amount of modification of the original text being negligible There is nothing that calls for special comment The former point of view is maintained without change, and the prospect it commands, though scanned in slightly greater detail in certain directions, preserves the same aspect Sir James Jeans's methods, as well as his conclusions, are highly original, and whatever may be thought of their validity, are singularly acute and penetrating. It is too early yet to form an estimate of their final value, but we may say with confidence that no consideration of the subjects with which they deal can afford to neglect so important a contribution

(2) It was a happy idea of the editors of the "To-day and To-morrow" series to pay some attention to Yesterday, and the choice of Sir James Jeans as historian could scarcely have been improved upon Readers of NATURE are familiar with the general character of the cosmogony which, during recent years, he has been engaged in constructing, and they will find here a clear and summary account of it in its most up-to-date form. The book is based on the Trueman Wood lecture delivered before the Royal Society of Arts on Mar 7, 1928, and a lecture on "Recent Developments of Cosmical Physics" at the University of London on Nov 9, 1926 Both these lectures were reproduced in NATURE shortly after delivery. The present volume, therefore, is to be recommended on account of its compactness rather than its novelty, and also for the illustrations of nebulæ and star clouds, of which six are excellently reproduced. The book is less an argument than a description, leading, as all scientific work does, to more questions than it answers For the reasons which have led to the conclusions presented, the inquirer must be referred to Sir James Jeans's larger work on "Astronomy and Cosmogony" It is necessary to say this because, taken alone, some of the statements appear to wear an air of confidence unjustified by the grounds on which they are based. Whatever may be the reader's reaction to the views expressed, however, the reading of the book will be accompanied by unalloyed pleasure. Sir James Jeans remarks that astronomy is a subject on which "one could hardly be prosaic if one tried". We have received many proofs that this is an under-estimate of human ingenuity, but if the remark be restricted to the present author we can give it whole-hearted assent.

(3) Prof. McWilliams's book is described as "a text for colleges" Cosmology is not a subject with which we are familiar in college curricula, but it is clear from the treatment that the book is intended mainly for Roman Catholics, for the viewpoint of the Catholic Church is taken through-

out It is impossible, therefore, for one who does not share that viewpoint to treat the discussion with much sympathy It does not appear to us, for example, that the author presents the most significant feature of the transition from Ptolemy to Copernicus in the following brief (and only) reference to the event "In the sixteenth century, Copernicus, a cleric and physician as well as astronomer, got out the system that is accepted to-day · thus was fulfilled the conjecture of St. Thomas that some day another system might supplant the Ptolemaic." Apart from matters of prejudice, however, the reasoning is not of the kind which is likely to convince the scientific mind What, for example, are we to make of the following argument to prove that "the assertion that the material universe is actually infinite in extent is contradictory in itself"?—"In any *extension* we can conceive a part to be subtracted, annihilated, or removed from consideration. Now the remainder is either finite or infinite. If finite, then that finite remainder plus the finite part removed equaled infinity, which is a contradiction If the remainder be infinite, then the void left by the part subtracted constitutes a limit to the infinite remainder; and by restoring the part we add to the actually infinite: all of which is contradictory" We can only say that those to whom such arguments appeal will find here a systematically classified text-book, each chapter of which contains a concisely worded thesis, arguments in favour thereof, a statement of possible objections with the replies thereto, and a list of references to other relevant literature The book is clearly written and well produced H D

Hurricanes in the West Indies.

Los Huracanes en las Antillas. Por Rev. Simón Sarasola, S.J. Segunda edición, aumentada con el Apéndice: Génesis y Evolución del Huracán de 20 de Octubre de 1926 y Catálogo de Ciclones en la Isla de Cuba de 1865 a 1926, por Rev Gutiérrez Lanza, S J Pp. xv+254 (Madrid Bruno del Amo; Habana "La Moderna Poesía", 1928)

THE early appearance of a second edition of this useful treatise on the hurricanes of the West Indies by the Director of the Colombian Observatory at Bogota suggests that the work has already been found serviceable in that part of the globe.

It appears that there is a suggestion of an English translation before long, which seems a highly desirable proposition in view of the number of British colonies in the West Indies Incidentally, such a translation would very considerably lighten the labours of an English reviewer who now asks the author's indulgence for any shortcomings resulting from unfamiliarity with Spanish

The treatise opens with a general account of the circulation of the atmosphere and the character of cyclones, with a discussion of the different kinds of clouds, illustrated by some good photographs, among which is a thundery cumulo-nimbus of superb proportions. It then goes on to the proper subject matter more specifically, dealing with the signs of approaching hurricanes, differences in their intensity and in the frequencies of the tracks they pursue in different months of the year It is shown how far European methods of forecasting storms based upon the principles of Bjerknes, Guilbert, Vercelli, and others are locally applicable, and a considerable amount of space is given to the theory of tropical revolving storms The concluding part of the book discusses the correlation between hurricanes and sunspots and other indices of solar activity, but, as usual in this field, without any very decisive results

Tropical cyclones appear to make up for their greater violence by being distinctly less frequent than those of extra-tropical latitudes, although a comparison is rendered difficult since there is no evidence of uniformity in the criteria adopted for defining a West Indies hurricane and a European gale A catalogue at the end of the volume shows that in the single island of Cuba, eighty-five 'hurricanes' of varying intensities occurred during the sixty-two years, 1865–1926, giving an average of one or two a year, whereas the number of 'general gales' in the British Isles average about ten yearly

As in all other regions devastated by tropical storms, the West Indies suffer most in the later summer and autumn months Thus, out of 239 cyclones of varying intensities recorded in the West Indies between 1887 and 1923, May had 1, June 16, July 17, August 39, September 78, October 71, November 15, and December 7.

The author presents a very impartial and open-minded account of the vexed question of cyclonic genesis, and states his own views on the subject We should like to suggest that he might here have effected to advantage some unification of ideas Whereas he favours the view that the tropical disturbances arise from the encounter of opposing currents, he does not take kindly to Sir Napier Shaw's suggestion that polar front principles may be applicable in this region Now hurricanes in the West Indies, as in other tropical regions, occur

just at the time of year when the migrating trade wind system, having reached its farthest position across the equator, is likely to be more heavily charged with moisture than the other trade system which it encounters Hence there is likely to be some kind of 'front' or 'discontinuity' in the trough of relatively low pressure between the interacting trades where the cyclones form, and there is actual evidence that humidity 'fronts' in the doldrums may play a more important part in storm production than thermal fronts, which are so pronounced in temperate latitudes (See, for example, C S Durst, *M O Geophys Mem*, No 28, 1926)

We think it should be better realised by writers on the theory of cyclones that there is nothing to warrant the assumption that these, any more than other natural phenomena, are to be explained in terms of a single cause There must be various contributing collateral and sequential factors involved in the 'cause of cyclones'

The appendix gives a vivid narrative of the dreadful cyclone that devastated Cuba in October 1926. The Meteorological Service issued timely warnings, and such measures as were practicable to lessen the number of fatalities were taken in the city of Habana and elsewhere. It is quite clear that cyclones in the West Indies are taken very seriously, as well they might be A bad storm may take a day or two to pass over a district, may bring 10 to 20 or more inches of rain in twenty-four hours, and wind blowing at the rate of 100 to 150 miles per hour. There can be no question that when the area covered and time occupied by such violence of wind and rain are considered, the tropical cyclone must be regarded as the most formidable type of storm that occurs on this planet, with the possible exception of the great snow-blizzards of colder climates.

L C W. B

Our Bookshelf.

The Normal and Pathological Physiology of Bone: its Problems By Prof R Leriche and Prof A Policard Authorised English Translation by Prof Sherwood Moore and Prof J Albert Key Pp 236 (London: Henry Kimpton, 1928) 21*s* net

"LES problèmes de la physiologie normale et pathologique de l'os" of Leriche and Policard was published in Paris in 1926 The two American doctors to whom we are indebted for this translation plead difficulty in excuse of defects which are indeed evident. There are, however, few obscurities which cannot be resolved without access to the original The French title is to be preferred to the English, because it modestly emphasises the 'problems' instead of the physiology The work is, happily, not physiological. It is incorruptibly biological, and in this its remarkable character lies "Areas in process of ossification are in reality regions with a sluggish circulation, with difficult interchange. The composition of the blood in the great vessels permits no deduction concerning the chemical behaviour in these areas That is the weak point of all chemical research up to the present time The methods are most exact, but that is not true of the object subjected to research. The problem on the whole is badly put And when well put, the methods are no longer applicable" Bone formation is a succession of phenomena: hæmorrhage, 'dedifferentiation' of connective tissue, œdema, resorption of bone and its deposition in the ossifiable medium present Each of these phenomena is in itself commonplace "What is peculiar is their juxtaposition The essence of the process lies in a vascular congestion acting simultaneously on the connective tissue and a calcified tissue" It is an organic result The work should be in the hands of every English surgeon, both on account of its extensive practical wisdom, and as an instruction in methods of research It is a little distressing to see the word 'evolution' so carelessly used The original conveys a variety of meanings.

The Economics of Rail Transport in Great Britain By C E. R Sherrington Vol 1 *History and Development*. Pp. xii + 283. Vol. 2. *Rates and Service*. Pp xii + 332 (London: Edward Arnold and Co, 1928) 12*s* 6*d* net each vol

MR. SHERRINGTON's two volumes are complementary to each other, each containing the same foreword by Sir Guy Granet and the same preface, while the first volume, after a short chapter on the function of transportation, deals with the growth of British railways, their rolling stock, locomotives, tracks, and the regulations which are part of their history, the second volume treats of the organisation and administration of railways, and their relation with the State, the public, and industry His wide experience as a lecturer on economics and as secretary to the Railway Research Service enables him to write in an impartial yet authoritative manner, and no one interested in railways could fail to appreciate his masterly review. The history of the British railways treats of them in the four groups as we see them to-day, the review of the locomotive development is more general. As to railway administration, the trend is towards a closer study of the internal economy of railway management, and from the second volume the layman can obtain some impression of the complicated nature of the problems involved

Regarding nationalisation, Mr. Sherrington remarks that "it is hard to visualise in the case of the railways any very great advantage in the change over under present conditions, and it certainly would tend to decrease any desire to improve efficiency"; while in his discussion on

road transport he says, "where ruthless competition for traffic not sufficient to warrant the two systems is taking place, its development should be opposed provided the rail method satisfies public wants, and can be operated more cheaply".

Matriculation Botany: a New School Course. By Mary A Johnstone. Pp xii + 324 (London and Toronto. J M Dent and Sons, Ltd; New York. E P. Dutton and Co, 1928) 4*s* 6*d*

IN spite of the number of school text-books of botany already available which cater for the needs of candidates of matriculation standard, teachers of such pupils would be well advised to consider Miss Johnstone's manual The author thinks that "to a large extent general knowledge of plant life is best acquired through the detailed study of the life-histories of a few specially selected plants", ecology being treated as an integral part of plant study from the beginning Carrying out this idea, she uses the life-histories of bluebell, lesser celandine, coltsfoot, and wheat as starting-points for a thoroughly sound school course on the physiology, structure, classification, and adaptation to environment of common plants. The section on soils and the notes on common trees are also worthy of special mention.

The skilled teacher is in evidence throughout the book, and the scientific spirit is displayed in such comments as the following: "Because these are advantages they must not be assumed to be the reasons" (why certain trees are deciduous)—an example of the kind of warning of which students of botany are in constant and peculiar need The 120 illustrations are excellent examples of the line drawings which pupils should be required to make—except in one respect the scale of magnification or reduction is consistently not stated. It is, indeed, conceivable that unwary young readers might suppose, from an examination of the drawings of soil bacteria, that *Nitrosomonas* is not only of the general shape, but also of the size, of a tadpole! Another small fault, which should be rectified in the reprints which are sure to be called for, is the repeated reference to 'centimetres' of water on p. 259

Dynamics: a Text-book for the use of the Higher Divisions in Schools and for First Year Students at the Universities By A. S Ramsey. Pp xii + 259. (Cambridge · At the University Press, 1929.) 10*s* 6*d* net.

THIS book is intended primarily for students in the higher divisions of schools who intend to take an honours course of mathematics at a university, and also for university students preparing for a first honours examination The text is based upon courses of lectures given to first-year students preparing for the Mathematical Tripos, and it is assumed that readers are already familiar with elementary dynamics, and have an intimate knowledge of the elements of the calculus.

The subject is presented with logical precision, and in a manner which is admirably appropriate to the requirements of those students for whom the book is intended An excellent feature is the wide range of worked examples given in each chapter, and to these are added extensive series of exercises taken either from scholarship papers or from Tripos papers The contents of the chapters include kinematics, kinetics, dynamical problems in two dimensions, harmonic motion, motion under constraint, the law of reaction, impulsive motion, orbits, moments of inertia, energy and momentum, equations of motion, miscellaneous problems, and small oscillations

Vorlesungen uber Elektrizitat Von Prof A. Eichenwald Pp viii + 664 (Berlin Julius Springer, 1928.) 36 gold marks.

PROF. EICHENWALD'S book has been carefully written and carefully printed; the list of corrections contains only one small item The text extends to 659 pages and contains 640 diagrams. In Great Britain it would probably have been published in two or three volumes It is divided into three parts The first part includes the main principles on which the sciences of electricity and magnetism are founded. The treatment is on the best academic lines, only the main mathematical theorems being given. The second part discusses electrons both in liquids and gases, radioactivity, and electric and magnetic phenomena connected with electrons. In the third part the theory of alternating currents is given, special stress being laid on oscillations and waves The practical theory of radio communication is also discussed. In the final chapter the theory of Rontgen rays is given, and also the quantum theory Maxwell's theory is given fairly fully, and some of the theorems of relativity We notice that the gauss is used for the unit of magnetic force and the maxwell for the unit of magnetic flux With the notable exception of J instead of I for current, international symbols are used

The Preparation of Plantation Rubber. By Sidney Morgan With a Preface and a Chapter on Vulcanisation by Dr. Henry P. Stevens Second edition Pp. xvi + 357 (London: Constable and Co., Ltd, 1928) 21*s* net.

INFORMATION gathered at first-hand is here given concerning the production and treatment of rubber, the main theme being its preparation for the market Mr. Morgan, who has drawn fully upon his extensive researches on such processes as tapping, coagulation, rolling, drying, and smoking, deals with operations in the field and factory, and contributes other sections on machinery and buildings, finished rubber, and general matters, while Dr. Stevens supplies the preface and an outline of the important subject of vulcanisation. Among new matter included in the second edition, attention is directed in particular to bud grafting, cover plants, and manures The book is well produced, generously illustrated, and full of valuable practical information which cannot fail to be of service to all who are concerned with the growing, curing, packing, manufacture, or general handling of rubber and rubber goods

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Diffraction of Electrons by a Copper Crystal.

INVESTIGATIONS of the secondary electron characteristics of a poly-crystalline copper surface have shown that maxima and minima appear in the low-voltage region of the total secondary electron curve only after the copper target has been heated at rather critical temperatures (*Phys Rev*, **25**, 41; 1925). Accompanying the appearance of these maxima and minima, a change has been observed in the angular distribution of the secondary electrons (*Phys Rev*, **31**, 414, 1928). These considerations, together with others (*Phys. Rev.*, **31**, 419, 1928), make it appear that the changes in slope in the low voltage region of the characteristic secondary electron curve of a metal are a function of the orientation of the surface crystals, as are also the directions of the scattered electrons

It thus appeared advisable to measure the total secondary emission from a single copper crystal under the same conditions as the angular distribution of scattered electrons. This has been done for bombarding potentials between 1 and 150 volts.

The apparatus is constructed of molybdenum to eliminate magnetic effects, and the earth's field is compensated by Helmholtz coils A special type of electron gun is used which produces a more intense beam of electrons than the usual type for the very low voltages (*J O S.A. and R S I.*, **15**, 290, 1927) The electrons strike at normal incidence the (100) face of the copper crystal which is placed at the centre of a drum One edge of the drum is made with a slot so that electrons may pass through and into the opening of the double Faraday box, which may be rotated from the plane of the target to within 13° of the incident beam The target may also be rotated about an axis perpendicular to its face and may be removed into a side tube where it may be heated to red heat by bombardment The moving parts are operated by magnetic controls which are sufficiently far removed to cause no measurable effect at the target. In taking observations on angular distribution the potential of the inside Faraday box is so adjusted that electrons which have lost more than 1 volt at the target are not permitted to enter

The total secondary electron curve shows two maxima in the low-voltage region at 3 volts and 10 5 volts respectively. Several marked changes in slope occur in the region between 10 5 volts and 150 volts Intense electron beams are found to issue from the crystal at potentials for which the above maxima occur and at such potentials as to account for many of the changes in slope between 10 5 and 150 volts. Others may be accounted for by the diffraction beams which would be expected to leave the crystal in the direction of the normal but are outside of the solid angle of observation. It thus appears that the energy levels of the atom at most play only a comparatively small part in the production of sudden changes in slope in this region, since the electron diffraction beams apparently depend only on the positions of the atoms and not on their structure.

Now, a consideration of the wave-length of the electron and the atomic spacing of a copper crystal shows that no electron beams due to diffraction are to be expected in the very low-voltage region in the solid angle accessible to observation, since the plane grating formula $n\lambda = d \sin \theta$ must be satisfied, and the maximum possible wave-length is obtained for $\sin \theta = 1$ Hence most of the beams in the low-voltage region have no X-ray analogues. They do occupy, however, the approximate positions to be expected by a wave of one-half the length given by the usual expression $\lambda = h/mv$, if a value greater than unity is taken for the refractive index.

Seven sets of electron beams are found to issue from the crystal in the two principal azimuths which are the X-ray analogues and require a refractive index greater than unity In addition, 8 sets of beams are found in the (100) azimuth which may be accounted for by assuming a wave-length for the electron which is one-half that given by the formula $\lambda = h/mv$. One other weak set in this azimuth is unaccounted for by either of the above relations In the (111) azimuth 3 sets are accounted for by the one-half λ relation. There are 4 other sets in this azimuth, 3 of which may possibly be accounted for by a one-third λ relation, while one weak set appears anomalous In addition to the above, the 3-volt beams do not appear accurately in either azimuth and are not reproducible.

Many of the beams are remarkably strong and sharp In the case of a 70-volt beam, the background scattering in azimuth is found under the best vacuum conditions to be only 4·3 per cent of the maximum intensity of the beam

The sets of electron beams accounted for by the above relations, with one exception, require a refractive index greater than unity. However, the voltage differences between the electron beams and their X-ray analogues are found in general to increase with the voltage from about 6 or 7 volts for the lowest, to about 30 volts for the highest voltage in the range below 150 volts The exceptional set, which is very weak, requires a refractive index of about unity with the association chosen.

The electron beams satisfying the $\lambda/2$ relation would also be accounted for by whole λ wave-lengths and twice the atomic spacing for a copper crystal and might thus suggest a surface gas grating having twice the copper spacing. Such plane grating beams have been observed by Davisson and Germer (*Phys. Rev*, **30**, 705, 1927) from the (111) face of a nickel crystal. The beams observed from the copper crystal, however, appear not to be due to gas, for they are space-grating beams and not surface-grating beams. Further, they are observed under the best vacuum conditions, which must be of the order of 10^{-8} mm. mercury, and only a few minutes after the crystal has been heated at red heat, that is, while it is still considerably above room temperature A temperature effect of these beams has been observed similar to that of the whole λ beams. The beams attain their maximum intensity about one half-hour after heating The copper crystal has been heated at red heat for several hours so that no pressure is observable on a sensitive McLeod gauge (a distance of 0 75 mm. in the top of the gauge capillary corresponds to 10^{-6} mm. mercury), while the crystal is at red heat.

If the possibility of an effect due to gas is ruled out, it appears necessary to conclude either that there are wave-lengths associated with the electron in addition to that given by the formula $\lambda = h/mv$, or that the electron waves are scattered from alternate rows of the copper atoms with different intensities, both in the plane grating and the space grating. Because of the 4-fold symmetry in azimuth, the crystal appears to be single. Since the crystal was formed by the method of melting and slow cooling in an atmosphere

of hydrogen, the possibility of contamination by copper oxide should be eliminated The experiments will be continued with other crystals

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Some further Observations on *Amoeba proteus*.

DR. MURIEL ROBERTSON's paper entitled "Notes on certain points in the Cytology of *Trypanosoma raiæ* and *Bodo caudatus*" (*Paras.*, vol 19, No 4, Dec. 1927) made me resolve to re-investigate the nucleus of *A proteus* in the various stages of its life-history by means of Feulgen's Reaction. A full account of this chemical test for chromatin, as well as a Table of Procedure, drawn up from her own experience, is given by Dr. Robertson. I had to modify this table in some respects. *A. proteus* is too heavy to remain adherent to the slide during all the drastic procedure involved in bringing about the reaction I therefore made use of the method used on previous occasions, that is, of carrying on all the operations in a centrifuge. As it was not practicable to wash the amoebæ in running water, the liquid in the centrifuge tube was replaced by water, and this was changed five times, at 15-minute intervals.

Dr. Robertson placed no ban on acid-containing fixatives. I therefore began my experiments by using Bouin's modified formula (Duboscq Brasil, 1905). The formalin in it helped to harden the cytoplasm. It was found necessary in the case of *A. proteus* to treble the time allowed by Dr Robertson. That this need was due to the nature of the *A proteus* nucleus rather than to the modifications in method described above, was proved by control experiments in which flagellates and ciliates were found to be brightly coloured after normal exposure to the stain.

The interesting new fact that emerges from this study is that the *whole* of the karyosome of the *A. proteus* nucleus gives the reaction for chromatin just as positively as does the macro-nucleus of a ciliate. Amid the general substance of the karyosome irregular patches are more deeply stained and the chromatin 'blocks' in the periphery are also a deep red. The achromatic structures show up in marked contrast, especially when light-green is used as a counterstain. None of the cytoplasmic structures are affected by the Feulgen, with or without hydrolysis

Consequent on the failure to obtain positive results for the karyosome of the nucleus of young, immature *A proteus*, even after prolonged staining, non-acid corrosive alcohol and absolute alcohol were tried as fixatives, lest the failure should be due to the Bouin's fluid previously used The results were the same; the karyosome again failed to give the reaction. The 'blocks', which are extremely small, were faintly red, and there was a diffuse red stain surrounding the blocks in the periphery. The nucleus of the young *A. proteus* would appear to contain very little chromatin, a conclusion borne out by its great affinity for plasma stains.

The colour produced by fuchsin after fixation in a non-acid fixative is much more pink and less purple.

This study has necessitated a renewed and detailed scrutiny of many cultures of *A. proteus*, and in view of the fact that a flagellate stage, followed by syngamy, has recently been described as occurring in the life-cycle of *A. proteus*, I should like to record, once more, that in spite of years of study I have failed to find any such stages. The life-cycle, in fact, would appear to be wholly asexual.

Amoeba bigemma bears a superficial resemblance to young stages of *A. proteus*. It can easily be cultivated under the same conditions as *A proteus*. *Amoeba verrucosa* similarly grows readily under these same conditions, and when it is young is extremely active in movement. Stained preparations of each of these could easily be mistaken for young *A. proteus* from their nuclear characters, unless the cytoplasmic characters of each had been observed before fixation of the specimen. So far as I am aware, the life-cycle of neither of these species has been worked out, and therefore the existence in them of a flagellate stage is not excluded, although in my opinion unlikely

Cultures of *A proteus* are liable to be attacked and even killed off by a flagellate parasite, and it is conceivable that this has been interpreted as a phase in the normal life-cycle of the amoeba.

It is of interest to note that in 1918–19 a strain of *A. proteus* was observed to contain symbiotic green flagellates The culture was unfortunately exhausted for supplying class and demonstration material. I have never had time to investigate the matter nor to make any experiments in bringing about the conditions which induced the symbiosis. The symbiont has a nucleus, typically flagellate, of about 60 μ, and its own diameter in stained preparations is from 150 μ to 180 μ. Some of these preparations contain four symbionts in a single amoeba.

Although *Euglena nematoides* is a frequent inhabitant of *A. proteus* cultures, the amoebæ do not seem to be able to prey upon it as they do on other flagellates, at least in its active stage. Although I have often watched a conflict between the two, I have always found that the *Euglena* makes its escape.

MONICA TAYLOR.

Notre Dame,
Dowanhill, Glasgow,
May 25

Negrito Racial Strain in India.

IN a short note in NATURE of May 19, 1928 (vol. 121, p 793), I mentioned the discovery of a truly negrito strain among the Kadars in the extreme interior of the Cochin Hills (S. India). As a result of further investigations in the adjoining hills made this year, I was able to find 10 more individuals showing spirally curved hair, making a total of 16 (a little more than 10 per cent) out of 157 men and women measured. Of the 10 individuals found this year, 8 were Kadars, and the remaining two were a Pulayan and a Malser The hair of all of these except two, who have very short spirals (Fig 1*a*), are of frizzly type similar to that of the Melanesians (Fig. 1*b*), matching No. '*g*' in Martin's scheme ("Lehrbuch", 2nd edition, vol. 1, p. 213). The hair of the two with short spirals would resemble '*h*' rather than '*i*' in the same scheme. In appearance they are without exception very dark, the skin colour varying from 29 to 34 in Von Luschan's scale, short, prognathic, having thick everted lips, short broad nose flattened at the root with the tip tilted up. The average cephalic and nasal indices of the 10 are 75 23 and 85·6 respectively, bringing them just within mesocephaly and platyrhiny

The presence of the Melanesian form of hair is interesting, because it definitely links up the aboriginal people of S India with Melanesia, but of the short woolly haired type I am not so certain. I am inclined to regard it as distinct from the frizzly haired type unless the latter may be considered the result of hybridisation with the wavy-to-curly-haired type which forms the dominant element among the Kadars at present. Whatever may be the ultimate explanation of this, there is no doubt that among the aborigines of S. India there still persists in the extreme interiors a primitive element of a genuine negrito

character, as shown by its occurrence not merely among the Kadars but also among the Pulayans and the Malsers It is not impossible that such a type exists among other aboriginal tribes of Southern and Central India in regions which have not so far been carefully explored. Dr. J H Hutton's discovery ("Man in

FIG 1 —Kadars of the Cochin Hills with woolly and frizzly hair respectively

India", vol 7, No 4, pp. 257-262) of spirally curved hair among a section of the Angami Nagas would extend it to the eastern frontiers and lend support to the view of the wide distribution of the negrito type at one time in India

The results of my investigations on the Kadars of the Cochin and Anaimalai Hills will be published as soon as the details are worked out

B. S GUHA.

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Penetrating Radiation and de Broglie Waves.

BOTHE and Kolhorster have recently published a preliminary account of an experiment on the absorption coefficient of the penetrating radiation (NATURE, April 27, p 638) They conclude that this radiation is of corpuscular rather than of gamma type The purpose of this note is to show that their experiment may be inconclusive

The de Broglie wave-length (de Broglie, "Ondes et Mouvements", 1926, p. 10) for an electron moving with velocity v is

$$\lambda_B = \frac{h\sqrt{1-\beta^2}}{m_0 v}$$

If this electron were suddenly stopped, the wave-length of the emitted quantum would be, on the basis of Einstein's photoelectric equation,

$$\lambda_F = \quad m_0 c \; 1 -$$

The ratio $$\frac{\lambda_E}{\lambda_B} = \frac{}{1-\sqrt{1-\beta^2}}$$

approaches unity for wave-lengths of the order of magnitude of those under discussion. For example, Millikan and Cameron (*Phys Rev.* [2], **31**, 921; 1928) give 0·00008 A. for the wave-length of their most penetrating radiation. If one takes $\beta = 0{\cdot}99999$, then $\lambda_E = 0{\cdot}000109$ A. and $\lambda_E/\lambda_B = 1{\cdot}0045$.

The results of experiments (Davisson and Germer, *Phys Rev.* [2], **30**, 705; 1927; Kikuchi, *Proc. Imp Acad. Tokyo*, **4**, 471, 1928) have shown that the de Broglie wave-length of low velocity electrons can be used to explain their reflection from and diffraction in crystals. It is suggested by analogy that, in the scattering of high velocity electrons and high frequency electromagnetic radiations of the same energy, the distribution in angle and the energy relations between the incident and scattered rays may be nearly identical.

If one assumes the mass of an electron and the mass of a quantum to be respectively

$$m_e = \frac{m_0}{\quad} \quad \ldots \; \overline{\quad c^2}$$

and uses the above expression for λ_E, it is seen that

$$\frac{m_e}{m_g} = \frac{1}{1-\sqrt{1-\beta^2}}.$$

For the velocity considered above $\frac{m_e}{m_g} = 1{\cdot}0045$.

From this, one may derive further grounds for extending, by analogy, the already established duality to the present case In the scattering formula of Klein and Nishina (*Zeits. f. Physik.*, **52**, 853; 1929), ν occurs only in the factor $h\nu/m_0c^2$. Therefore, if one substitute m_e for $h\nu/c^2$ the numerical result is changed only slightly for large values of β

If the above hypothesis should be valid, the analysis of penetrating radiations at the surface of the earth into electrons or light-quanta might be impossible by means of simple scattering or absorption experiments.

It is also possible that some of the rays from radioactive substances recently classified as short wave gamma-rays may in reality be high speed beta-rays.

F. T. HOLMES.

Sloane Physical Laboratory,
Yale University,
New Haven, Conn, May 23.

Magnetic Properties of Isolated Atoms of Cobalt.

FERRO-MAGNETISM is one of the most complicated and least explained subjects This is because in most of the experimental work what are observed are statistical phenomena from which it is difficult to arrive at a knowledge of the elementary mechanism. It was therefore thought interesting to investigate alloys of a small percentage of cobalt with platinum, namely, 10 per cent Co – 90 per cent Pt and 5 per cent Co – 95 per cent Pt, in which the ferro-magnetic cobalt atoms are not generally surrounded by other magnetic atoms, but by non-ferro-magnetic platinum atoms.

These alloys were found ferro-magnetic, the Curie point being 249° C. and 49° C for the 10 per cent and 5 per cent alloys respectively The magnetisation, I, at different temperatures, from that of liquid air up to the Curie point, was found for each alloy, the decrease in magnetisation near the Curie point being most rapid for the 5 per cent alloy. For small values of the applied magnetic force ($H = 0$ to 100 gauss), I increased at first with temperature, but for greater values of H it decreased steadily. The greatest values of I obtained ($H = 565$ gauss) were 364 and 254 C.G.S units for the 10 per cent and 5 per cent alloys respectively. This corresponds to a magnetic moment per cobalt atom 25 per cent and 60 per cent greater than that calculated from the saturation magnetisation of pure cobalt, assuming the platinum atoms do not contribute to the magnetisation.

Finally, various hysteresis loops, showing the relation between I and H, were obtained These were found to vary considerably with the heat treatment. For wires in the hard drawn state, the 5 per cent alloy gave the larger and more rectangular loops, with a coercive force as great as 100 gauss; but after annealing at different temperatures, the hysteresis was greatly reduced, the 5 per cent alloy showing a coercive force of only 20 gauss as against 28 for the 10 per cent alloy. This last result, for the annealed wires, is in accord with Heisenberg's theory of ferro magnetism based on the resonance between th

spinning electrons of neighbouring atoms (*Zeit f. Phys.*, **49**, 619, 1928), on this theory one would expect less hysteresis as the magnetic atoms become more isolated. The theory also explains the effect of annealing in reducing the hysteresis by uniformly distributing cobalt atoms which were closely clustered in groups in the hard drawn state, and thus likewise reducing resonance phenomena.

F. W CONSTANT
(National Research Fellow).
California Institute of Technology,
Pasadena, California, May 23.

The Atomic Weight of Arsenic.

As the International Committee on Atomic Weights has not provided a table since 1921, the British Sub-Committee published in the *Journal of the Chemical Society* of January last a revised table of atomic weights for 1929. In the report attached to this table we read that " for the nine ' simple ' elements H, He, C, N, F, Na, P, As, and I the values obtained by F. W. Aston with his new mass-spectrograph are adopted in preference to those deduced from the physical or chemical data, because we are of opinion that, in these cases, Aston's method is less liable to error than any other ". . .

Dr. Aston is to be congratulated that his spectrograph allows the reading corresponding, as regards the accuracy, to that of modern atomic weights determination, namely, 1 in 10,000.

Since from the year 1927 I have been engaged on the revision of atomic weight of arsenic, based on chemical analysis, I am highly interested in the new Aston figure, As = 74·934, derived for this element from the mass spectrum alone. The atomic weight of arsenic, As = 74 96, hitherto adopted internationally, is based on the Baxter and Coffin method of converting silver arsenate into silver chloride or silver bromide by the action of hydrogen chloride or hydrogen bromide. From the chemical point of view this international value for arsenic is a little higher than the actual one. From this reason I have undertaken a new determination of this figure deduced from the analysis of the purest arsenic chloride and bromide. From the eight determinations of the ratio $AsCl_3 \cdot 3Ag$ hitherto made, I have obtained the average As = 74·937 (using Ag = 107 88 and Cl = 35·458), which is in excellent agreement with the value obtained by Aston. This agreement corroborates the probability of the lower value, which was to be expected, and shows at the same time the trustworthiness of Aston's method used for the derivation of atomic weights of simple elements.

My preliminary paper concerning this matter was read before the Congress of Czechoslovak Scientists held in Prague, May 1928 After completion of the analyses of arsenic chloride and those of arsenic bromide, the definite value obtained will be published.

H KŘEPELKA.
Institute of Inorganic Chemistry,
Charles University,
Prague, May 7

A New Ultra-violet Band Spectrum of Hydrogen Chloride.

HITHERTO no band spectra have been found which involve electronic excitation in neutral or ionised hydrogen chloride We have recently photographed an extended band system in the region λ2830-λ3966 from a low pressure discharge in pure hydrogen chloride gas with platinum electrodes The bands are degraded toward long wave-lengths, and have the characteristic widely spaced structure always observed in hydride spectra. A discharge in hydrogen gives the same band system if a small amount of silver chloride or cuprous chloride is fused on the electrodes, but not if silver bromide is used. Thus there is strong evidence that this spectrum is due to the hydrogen chloride molecule. Moreover, there are reasons, both experimental and theoretical, for believing that the emitter is singly charged, probably the HCl^+ ion. For example, the bands are obtained only from the negative glow, whereas in general the spectra of ionised molecules, such as N^+_2, are relatively stronger.

Owing to the unusual intensity distribution in this band spectrum, it has not been possible to reach an assignment of vibrational quantum numbers, and thus to determine the electronic frequency. The isotope effect, which we hope to obtain by the detailed analysis of the fine structure now in progress, should prove helpful in this regard. The bands occur in pairs of constant separation, 658 cm.$^{-1}$, indicating that a doublet electronic level is involved. The two components of a pair have about equal intensities. The wave-numbers of the band heads may be represented by

$$\nu = \left.\begin{matrix}28446\\27788\end{matrix}\right\} + 1561p - 30\ 3p^2 - 2573n,$$

observed values of (p, n) being $(-1, 0)$?, $(0, 1)$, $(3, 1)$?, $(0, 0)$, $(1, 0)$, $(2, 0)$, $(3, 0)$, $(4, 0)$, $(5, 0)$. The pair $(0, 0)$ at λλ3514, 3598 is the strongest, and the five succeeding pairs have regularly decreasing intensity. They apparently form a progression with a common vibrational quantum number in the lower state As was pointed out to us by Dr F Hund, it can be shown by a correlation with the energy terms of the equivalent atom, Cl, and the separate atoms H and Cl^+, that a transition $^2\Sigma \longrightarrow {}^2\Pi$ might be expected in HCl^+ A preliminary examination of the rotational structure shows that it is probably compatible with such an interpretation.

BROOKS A. BRICE.
F. A. JENKINS.
New York University,
University Heights, N Y., April 26.

Dirac Equations and Einstein Theory.

HERMANN WEYL (*Proc Nat. Acad. of the U S A*, **15**, 323, April 1929) has recently developed a relativistic theory of the Dirac equation which, like that of Wigner (*Zeit. f. Phys*, **53**, 592, 1929), and that of Vallarta and myself (NATURE, Mar. 2, 1929, p 317), employs the Einstein notion of an '*n*-leg' Unlike the two other theories, Weyl rejects Einstein's distant parallelism, and obtains a theory invariant under a local rotation varying continuously from point to point. That is, Weyl's theory depends solely on the $g_{\lambda\mu}$'s of Einstein's 1916 gravitational theory, and not on the ${}^s h_\lambda$ of his 1929 theory. It is perhaps interesting to remark that the same degree of invariance may be obtained by choosing as the 4-legs of the Einstein theory the Ricci principal directions. If we write $R_{\lambda\mu}$ for the 1916 contracted curvature tensor, this additional condition is expressed by the formula

$$_t h^\mu {}_s h^\lambda R_{\lambda\mu} = 0 \quad (s \neq t). \qquad . \qquad . \quad (1)$$

This condition is trivial and nugatory in case the original Einstein equations $R_{\lambda\mu} = \text{const}\ g_{\lambda\mu}$ are fulfilled. Since the new gravitational-electric-matter equations, whatever their final form may be, are close approximations to these, it is perhaps not too much to hope that the supplementary condition (1) not only is compatible with them, but even not too restrictive so far as terms of observable magnitude are concerned.

Thus gravitational phenomena appear to be such

as can occur even in a homogeneous Riemann space, whereas matter-electrical phenomena depend on the inhomogeneity of space This may well have something to do with the absence of spherical symmetry in the spin inseparable from the electron

So far as the quantities ${}^{s}h$ are concerned, the new auxiliary condition is of the second order The new Einstein field equations will probably not be of the second order when written in terms of the $g_{\lambda\mu}$'s, but it is not clear that the Weyl equations will escape this criticism. The supplementary condition (1) leaves untouched the work of Wigner, Vallarta, and myself Thus the Dirac equations may be treated relativistically on the basis of the Einstein 1916 theory

NORBERT WIENER

Massachusetts Institute of Technology,
Cambridge, Mass., U S A., May 8.

Diamagnetism and Crystal Structure.

PROF EHRENFEST has suggested (*Physica*, vol. 5, p 388, 1925) that the high diamagnetic susceptibility of bismuth is to be ascribed to the existence in the metallic crystal lattice of electron orbits of large area including several atoms within their radius. There seems good reason to extend Ehrenfest's hypothesis to the case of carbon as well, since it affords an illuminating insight into the magnetic behaviour of the different forms of this element It is known that graphite possesses a high specific susceptibility, which according to the most recent measurements of Vaidyanathan with carefully purified samples, is $-5 \cdot 1 \times 10^{-6}$, that is, quite ten times larger than the specific susceptibility of diamond ($-0\ 49 \times 10^{-6}$), the latter being practically the same as that of carbon in organic compounds as found from Pascal's additive law. The abnormal susceptibility of graphite becomes intelligible in terms of the peculiar structure of the substance and its electrical conductivity, if we assume that there are electron orbits circulating round the plane hexagonal rings of carbon in the crystal-lattice This fits in with the known fact (observed by Honda and Owen) that the susceptibility of graphite is six or seven times greater normal to the planes of cleavage than parallel to them Diamond, on the other hand, being a dielectric would naturally not show the abnormal susceptibility

Careful studies made by Mr. P Krishnamurthi of the X-ray pattern of sugar charcoal and lamp-black prove conclusively that these substances do not possess any crystalline structure. The fact that amorphous carbon has the normal susceptibility ($0\ 51 \times 10^{-6}$), and not the high value of graphite, is therefore quite to be expected. The great diminution in the susceptibility of bismuth which occurs on fusion may be regarded as an analogous phenomenon.

Ehrenfest's hypothesis would appear to have also other fruitful applications, for example, in the explanation of the remarkable diminution in the susceptibility of graphite at high temperatures and of the dependence of susceptibility on particle size in colloidal substances We need not, however, enter into those details here C. V. RAMAN.

210 Bowbazar Street,
Calcutta, May 23.

Salt Haze.

I HAVE at intervals during the last few years directed attention to the presence of salt particles in the air and their importance in facilitating the formation of fog, since in the presence of a haze of sea salt condensation would commence upon the particles long before saturation is reached.

On May 27 last I was fortunate enough to observe a salt haze in process of generation. I was on the north bank of the Tagus at about 8 A.M, summer time. It was a bright sunny morning, with a light wind from the north-west, and looking across the river I observed a long stretch of sandy shore extending southward from the mouth of the Tagus I had a good view along this stretch of shore, and noticed that a well-marked haze commenced along the line of the breakers and was carried seaward by the wind, extending gradually so that it partly obscured the hills in the distance There was a clearly defined line over the breakers where the haze commenced, and it was obviously formed from the spray. On looking in the opposite direction over the land visibility was good, and practically no haze was to be seen.

Later in the day, that is about 11 A M., in passing up the coast northward from the Tagus I saw another example of the same thing

In a small bight or bay of the coast there was a large number of rocks projecting from the water, and these caused a good deal of disturbance and spray due to the waves; from the surface of this bay a drift of haze was quite visible passing inland The sun was shining brightly at the time, and in this case, as well as in the first mentioned, the haze was white. In the latter case, doubtless the fine salt particles were carried inland to a considerable distance It is possible that few of them survive the cool, still night, when the air becomes cooled and condensation on the particles must tend to bring them down.

J. S OWENS.

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Rise and Fall of the Tides.

IN NATURE of April 27, Mr. A Mallock writes on rise and fall of the tides, and illustrates his views by three specific cases in which a constant amount of energy is continually concentrated into a diminishing mass To quote briefly. A heavy flexible cord passes through a hole in a fixed horizontal plate. The part below the plate is given an initial oscillation and swings as a pendulum The cord is then drawn upward through the hole The part above the plate is stationary, and the energy it contained is transferred to the part still hanging free, the mass of which continually decreases. Hence the velocity of oscillation tends to become infinite when the length vanishes.

Surely in this case it has been overlooked that as the cord is pulled up work is being done against the centrifugal acceleration, so that the kinetic energy of the moving portion is not constant, but is continually increasing?

The case is analogous to that of a conical pendulum formed by a bob at the end of a string; if the string be shortened by any means the kinetic energy of the system is increased. The same principle occurs in two common forms of human activity; the child swinging rhythmically raises his centre of gravity while his angular velocity is great and lowers it while it is small, the skater, moving over the ice by what is known as the Dutch roll, progresses by a series of alternating curves, never lifting his skates from the ice He rhythmically raises his centre of gravity while going round the curve (*i e.* shortens the conical pendulum), and lowers it while reversing the curvature of his path By this means he steadily puts energy into the moving system, without its being obvious to the non-skater how he is doing it.

L H. G. DINES.

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Teddington, Middlesex, May 20.

The Late Palæozoic Glaciation.

By Dr H DIGHTON THOMAS.

THE great continent of Gondwanaland existed in the late Palæozoic in the southern hemisphere and persisted through a long period of geological time with little modification. The deposits formed on it are found in Australia, India, South Africa, South America, and Antarctica, where beds of glacial origin generally occur at the base of the series The fossilised remains of the flora which flourished on the continent in its early stages are found sometimes in, and generally above, the glacial horizon Characteristic plants are species of *Gangamopteris* and *Glossopteris* The whole floral assemblage is very different from that yielded by the Upper Carboniferous and Permian continental deposits of the northern hemisphere, in which the Pteridosperms (*e g. Alethopteris*), Lycopodiales (*e g Lepidodendron*), Equisetales (*e.g. Calamites*), and Cordaitales (*e g Cordaites*) predominate.

Intimately linked with the problems of Gondwanaland are the questions of the age of the late Palæozoic glaciation and of the age and range of the *Glossopteris* flora. Was the glaciation in Carboniferous [1] or in Permian time? Did the first members of that flora exist contemporaneously with the latest Carboniferous flora of the northern hemisphere, or did they make their appearance later, in the Permian? For long, different opinions have been held, though in general those of British geologists have tended more and more definitely towards a belief in a Uralian age (Upper Carboniferous), both for the glacial period and for the entry of the *Glossopteris* flora. Prof. C Schuchert has recently attempted to answer the question decisively (*Bull Geol Soc. America*, vol. 39, No. 3, 1928, pp. 769-886), and in doing so has performed an invaluable service in bringing together in an accessible and summarised form a mass of stratigraphical and palæontological details In his long paper Schuchert deals with the evidence furnished by most of the important localities in the southern hemisphere and in India To these he adds résumés of the important Russian, German, and North American horizons which bear on the problem to be solved. His conclusions briefly are that the glaciation occurred "in Middle and probably in Late Middle Permian time", and that the *Glossopteris* flora does not range back beyond that period. In these conclusions Schuchert states that he has the support of Dr. David White, the noted American palæobotanist

Fundamentally, in making his correlations Schuchert uses as a standard the succession in the Salt Range, so that the determination of the age of the latter is of prime importance The whole of the Productus Limestone and of the underlying beds down to the Talchir Boulder Bed he assigns to the Permian, firstly, on the evidence of Upper Permian ammonites (*Xenaspis* and *Cyclolobus*) in the Virgal and Chideru groups, and secondly, because of "how intimately the whole of the Productus Limestone is tied together faunally" The latter statement rather overstates the case The number of species, particularly of the Brachiopoda, that range through the Productus Limestone Series is small, and it is highly dangerous to use such long-ranged forms in correlation The ammonites give the age for the containing beds, but are no proof of the age of those below them. They first occur in the Salt Range in the zone of *Xenaspis carbonaria*, the whole of the succession of about 800 feet below that horizon down to the glacial bed being devoid of such forms The age of these beds can be deduced only from a consideration of their faunas, and particularly from the Brachiopoda, because of the knowledge we possess of their range in time.

From this point of view the first important fossiliferous horizon above the Talchir Boulder Bed is the Amb group of Noetling, approximately equal to the Lower Productus Limestone of Waagen; this Schuchert refers to the Basal Upper Permian The faunal evidence will scarcely support this opinion. From this horizon Waagen described a large fauna which has to some extent been emended by Noetling and Koken. The faunal lists given by the latter, and by Waagen, show a large number of forms which occur also in the Urals and in Timan. In that classic and standard area for the Upper Carboniferous most of the forms common to the Russian area and to the Amb Series do not range above the Artinskian (Lower Permian), and the majority of them not above the *Schwagerina* zone (Upper Carboniferous). As examples, *Dielasma itaitubense*, *Hemiptychina sublævis*, *Derbya regularis*, *D. grandis*, *Rhipidomella pecosi*, and *Spirifer ravanah* may be cited Schuchert himself draws attention to the fact that "The Amb stage is characterised below by *Spirifer marcoui*", a species which he is careful to state does not range higher than the *Cora* zone (Uralian) in the Urals. Even without considering the absence of such forms as the curious Brachiopod *Lyttonia* from the Amb fauna (which may not be an essential point in the argument) it becomes impossible to maintain for the Amb stage an age younger than Lower Permian. At the latest a low horizon in the Artinskian is indicated Such being the case the underlying Speckled Sandstone, including the *Eurydesma* and *Conularia* zones—important for the correlation of the Australian and South African successions—and the Talchir Boulder Bed are of high Carboniferous (Uralian) age

Some confirmation is given by the recently described fauna from the Umaria coalfield of Central India. Above a slight unconformity on the Talchir Boulder Bed occur thin marine, fossiliferous bands which are stated to pass up into the Barakar Series of continental origin The fauna is not a rich one, but its importance from its position above the

[1] The boundary between the Carboniferous and the Permian is here taken at the top of the *Schwagerina* zone and not, as drawn by Schuchert, at its base.

glacial horizon is obvious Cowper Reed placed its age as Permo-Carboniferous and directed attention to its affinities with an Upper Carboniferous fauna. It is doubtful if he implied by the use of the term 'Permo-Carboniferous' a definite Lower Permian age as Schuchert takes it to mean, it is more probable that he meant that the fauna might be either Upper Carboniferous or Permian in age, but that it is difficult to determine which from the evidence Even accepting a Lower Permian age for the fauna, it is difficult to see why Schuchert should reject such a determination, and state that the Talchir stage is Middle Permian, largely because the Barakar stage is stated to be Middle Permian The marine evidence is far more trustworthy than a correlation made through the fact that the beds pass up into the Barakar Series. Ultimately the latter has to be correlated with marine successions, since our standards are founded on them. From the evidence of the marine beds in the Umaria coalfield a Carboniferous age for the Talchir stage is not improbable. In the Indian Peninsula the latter stage, as well as the succeeding Karharbari stage, yields *Gangamopteris* and *Glossopteris*, so that there is strong indication that the establishment of the *Glossopteris* flora occurred at least in Lower Permian time, if not actually in the Carboniferous. The occurrence of *Gangamopteris* in Kashmir in no way invalidates this. The beds yielding them lie below the Permian Zewan beds, but the plant-bearing horizons occur at a distance of 400 feet at least below the base of the Zewan series.

The *Eurydesma* and *Conularia* faunas of the Salt Range are repeated in New South Wales and in South-West Africa, in both cases above glacial beds. If these faunas are reliable guides they indicate an Upper Carboniferous age for the Lower Marine Series of the Hunter River in New South Wales, and for the Upper Dwyka Shales of South-West Africa. Such an age has been accepted by Dr. Du Toit and Prof. Gregory among others. The latter has directed attention elsewhere to the Carboniferous, as opposed to the Permian, aspect of the fauna of the Lower Marine Series of the Hunter River succession Thus not only are the glacial beds at the base of that series proved to be of Upper Carboniferous age (an opinion shared with Prof. Sir T. W. Edgeworth David), but also the *Glossopteris* flora to have appeared in the Australian area at a similar time—leaves of *Gangamopteris* occur in places in some of the beds which comprise the Lower Marine Series An easy correlation can be effected between the Seaham Harbour Glacial Beds of New South Wales and the Bacchus Marsh Beds of Victoria, the Glacial Boulder Beds of Tasmania, etc. The Greta Coal Measures, with abundant *Gangamopteris*, most probably represent the top of the Carboniferous development in New South Wales, the Upper Marine Series still faunally close to the Carboniferous probably marking the beginning of the Permian.

On the Irwin River in Western Australia glacial beds are known to occur below marine horizons which are themselves overlain by Coal Measures If these latter are correctly correlated with the Greta Coal Measures of Eastern Australia, then the glacial beds which occur far below them in the sequence are also of Upper Carboniferous age. Of the fauna of the marine beds in the Irwin River area the most important member, in some ways, is *Paralegoceras jacksoni*, the only Cephalopod so far recorded from there Its affinities (and by the kindness of Sir Edgeworth David the writer has had the opportunity to examine several specimens) are with Upper Carboniferous forms, and as far as one may rely on this species it supports an Upper Carboniferous age for the bed which yields it in large numbers and for the glacial beds below. The rest of the fauna shows some anomalies, as Sir Edgeworth David has indicated It is unfortunate that Schuchert does not consider this glacial occurrence

Before leaving the question of the Australian beds, attention might be directed to the alleged presence of the ammonoid, *Agathiceras*, in New South Wales and in W. Australia As importance is often attached to this in making correlations (and Schuchert himself mentions the occurrence), it is not beyond the point to state that some time ago Dr Spath and I examined the specimens in the British Museum (Natural History) sent over as that species. They could all equally well be Bellerophontids. A few months ago I received a letter from Dr F W Whitehouse, of Queensland University, stating that he had published a note in Australia some three years or so ago to the effect that the so-called *Agathiceras micromphalum* is a Bellerophontid.

Reference has already been made to some evidence for an Upper Carboniferous age for the Dwyka Conglomerate of South Africa. The occurrence of the fish *Palæoniscus*, and of the crustacea *Anthrapalæmon* and *Pygocephalus*, in the Upper Dwyka Shales does not invalidate this, as Dr. Du Toit has pointed out. Dr. A. W. Rogers has expressed a similar view. Of great interest is the discovery of remains of the *Glossopteris* flora *beneath* the tillite at Strydenburg and at Vereeniging Prof. Seward and Mr. T. N. Leslie described the flora from the latter place—the *Glossopteris* and *Gangamopteris* leaves were associated with genera common in beds in the northern hemisphere, *Lepidodendron*, *Cordaites*, *Sigillaria*, and *Psygmophyllum*. These hardly demonstrate an horizon as high as Middle Permian, to which Schuchert assigns the Dwyka Tillite. The flora and the invertebrates together indicate an Upper Carboniferous age not only for the glaciation but also for the first members of the *Glossopteris* flora, an interpretation accepted by Prof. Seward. Du Toit has well said of another occurrence, "It might be remarked at the outset that the majority of the members of the *Glossopteris* flora are of *little or no value* in establishing the *absolute age* of the beds Recent work has been showing more and more that certain genera and species thereof had a long range in time . . ." The Ecca beds (2000-6000 ft. thick), which succeed the Dwyka Series, are, in Schuchert's view, of *Basal* Upper Permian age It is an amazing, though not necessarily incredible, development for such a small period of time

By means of the Upper Dwyka Shales, and more particularly from the "White Band", which yields the marine reptile *Mesosaurus tenuidens*, we can date the glacial deposits of South America. It is generally admitted that that band and the Iraty Black Shales of the Paraná Basin are contemporaneous, so that, granted that the "White Band" is Upper Carboniferous in age, the Iraty Black Shales, which yield species of *Mesosaurus*, are also of that age. But beneath them occur the Rio Bonito Coal Measures, with a typical lower Gondwana flora, including *Gangamopteris obovata* and *Glossopteris* spp., while lower down still are the Itarare Beds with a basal glacial horizon. Du Toit has also adduced evidence for a Carboniferous age for the glaciations in the San Juan area of Argentina, in which region he believes that the *Glossopteris* flora, if not actually occurring with elements of the Northern Carboniferous flora, occurs in beds which are only slightly later than those yielding *Cardiopteris*, *Rhacopteris*, etc. This glaciation and that of Barreal, where a glacial tillite is overlain by beds with a marine fauna shown by Cowper Reed to be of early Uralian age, receive scant reference by Schuchert.

Prof. Schuchert has performed an arduous task in compiling his lengthy work, and he deserves the thanks of all those who are interested in the problem with which he attempts to grapple. We may differ from him, and contend that the evidence he adduces is more in accord with a Uralian age for the late Palæozoic glaciation and for the first appearance of the members of the *Glossopteris* flora. But at least his arguments will stimulate renewed interest and thought on one of the big problems of the stratigrapher and of the palæobotanist.

The Hormones of the Sexual Glands.[1]

THE influence of the ovaries on other tissues is an established fact; less is known of the effect of other glands upon the ovaries, but evidence is accumulating that the maturity and periodicity of function of the female sexual glands depend on influences from other tissues or glands of the body. Grafting experiments have shown that an ovary from an immature animal inserted into the tissues of an ovariectomised adult reaches maturity sooner than it would have done in its original environment: a mature organ grafted into an immature produces no observable effects and becomes functionless. A. Lipschutz has obtained similar results when an ovary is grafted into a castrated male: if the animal—guinea-pigs were used—is an adult, hormonic effects, as shown by hypertrophy of the mammary glands, set in after 1½-3 weeks, but if the animal engrafted is not fully grown there is a latent period of about six weeks: ovaries from the same female may show these different latencies if grafted into males of different ages (*Jour. Biol. et Med. Exper.*, No. 6, p. 1, 1926). The grafted ovaries, however, do not usually show their normal periodicity, but enter into a state resembling prolonged œstrus.

Y. Tamura, working with mice, has, however, found evidence in some cases of the development of corpora lutea in grafted ovaries, the appearance of which suggested that they had been developed some time after the operation (*Proc. Roy. Soc. Edin.*, vol. 47, p. 148; 1927). He also found that the presence of the testis did not affect the vitality of the ovarian graft. That ovarian regulation is at any rate partly somatic is further shown by the fact that removal of one gland leads to hypertrophy of the other, showing that some bodily factor limits the number of follicles which can come to maturity at any one time. In this connexion it may be mentioned that T. Tadokoro, M. Abe, and S. Watanabe have found differences between the proteins of certain tissues in male and female animals of various species (*Jour. Facult. Agricult., Hokkaido Imp. Univ.*, vol. 23, p. 1; 1928).

Recent work indicates that the anterior lobe of the pituitary and also the thyroid glands exert a definite influence on the ovary. It has long been known that the former influences both bodily and sexual growth, and also that it hypertrophies during pregnancy; recent evidence suggests that at least two, if not three, different principles may be secreted by this gland, a growth-promoting, one hastening ovulation and sexual maturity, and one inhibiting ovulation by stimulating the development of lutein tissue. Precocious maturity in rats and mice can be provoked by injection of macerated aqueous suspensions of fresh anterior lobes, œstrus setting in after about three days: acid extracts produce this effect in concentrations which have no effect on growth in an adult.

The same hormone occurs in human placenta and the urinary secretion of pregnant women: experiments on filterability and adsorption indicate that it possesses a smaller molecule than the growth-promoting principle. On the other hand, alkaline extracts of less fresh glands produce growth together with luteinisation of the ovary: the follicles develop into corpora lutea without ovulation, and with enclosure of the ova, further ovulation is prevented. This luteal tissue sensitises the uterus to stimuli, produces mammary overgrowth, and, developed during pregnancy, results in prolongation of this condition. There is some evidence that the eosinophil cells of the anterior lobe of the pituitary are concerned with the stimulus to growth, whilst the basophils are in relation with the gonads (H. M. Evans and M. E. Simpson, *Jour. Amer. Med. Assoc.*, vol. 91, p. 1337; 1928). It is to be noted that the hormones of the pituitary act through the ovary; in the absence of the latter none of the effects upon the secondary sex characters are observed. The exact relationship between the anterior pituitary and the cyclic function of the ovary is not known, nor whether the secretion of hormones from the former is periodic.

The thyroid also has an influence upon the gonads,

[1] Continued from p. 915.

but whether direct or secondary to its coincident effect upon the general metabolism of the body is not known. G R Cameron and A B P Amies have shown that the administration of the dried gland to mice and guinea-pigs leads to a prolongation of œstrus, especially in the latter, and also to prolongation of the whole cycle in the mouse (*Austral Jour Exp. Biol and Med Sci*, vol. 3, p 37, 1926) Feeding fowls with thyroid produces changes in the plumage, which in males takes on a henny character (F.W.R Brambell, *Proc Roy Irish Acad.*, vol 37 B, p 117; 1926 M Nevalonnyi, *Bull. de l'école supér. d'agronomie*, Brno, 1928), but Brambell considers that this effect is not physiological but due to the toxic results of the dosing, which produces hyperthyroidism Apart from this change in type thyroid feeding has the same effects in both sexes B Zawadowsky (*Jour biol méd expér*, vol 5, p 344; 1927) has found that testicular degeneration in cocks and failure of egg-laying in hens follows the administration of thyroid, again presumably a toxic effect

It may be remarked in passing that the secretions from both the anterior lobe of the pituitary and the thyroid gland are essential for growth and maintenance of normal health and any derangements will presumably affect the gonads just as the other tissues of the body, on the other hand, alterations of the œstrous rhythm may occur independently of other obvious bodily changes, suggesting that these glands may have a specific influence on the gonads or that the latter are more sensitive to their stimulation than the somatic tissues of the body.

THE TESTIS.

The male sexual gland is responsible for the development of the secondary sexual characteristics, as the ovary is in the case of the female Like the latter organ, it consists of cells from which the specific sex cells are developed and also of interstitial cells which lie between the seminiferous tubules. it is generally held that the latter are the source of the hormone responsible for the appearance and maintenance of the secondary characters, since an organ in which the tubules have degenerated, such as an autotransplant, can still produce an internal secretion Testes always become functionless, so far as regards the formation of spermatozoa is concerned, when removed from the scrotum, either by transplantation or by fixation in the abdomen, and the same phenomenon is observed in naturally undescended organs, as in the case of unilateral cryptorchism in a rat described by W. P Kennedy (*Jour. Anat*, vol 61, p. 352, 1927) The degeneration appears to be caused by the higher temperature to which the organ is exposed

On the other hand, some authors consider that the function of the interstitial cells is nutritive rather than internal secretory, basing their opinion on the histological appearances of these cells and on the presence in them of lipoid granules which are not specific in nature and may also occur in cells of the tubules which give rise to the spermatozoa (M. Parízek, *Publ Biol de l'école vét*, Brno, vol 2, p 293; 1923 S Morgenstern, *Jour. médico-biol*, Fasc 4, p 29, 1925) In this case the internal secretion of the testis must presumably come from the external layer of cells of the seminiferous tubules which usually survive in a degenerated organ.

The influence of the male gonads on metabolism has been followed after both castration and also the injection of testicular extracts In general, the results obtained so far have been rather inconclusive since they are irregular and slight in degree. T. C Shen and K H Lin have found no appreciable difference between the nitrogen excretion in the urine of eunuchs and normal men creatine was found in one case, and the daily output of creatinine was variable in another, whereas normally creatine is absent and the creatinine excretion constant (*Chinese Jour Physiol*, vol 1, p 109, 1927) Castration has no effect upon the level of the blood calcium (L. Perelman, *Jour médico-biol*, Fasc 3, p 52, 1925)

V Korenchevsky has investigated the effects of castration and injection of extracts of testis and prostate upon the metabolism of rabbits and dogs in a series of papers (*Brit Jour. Exp Path*, vol. 6, pp 21, 74, and 158, 1925 · *Biochem Jour*, vol 19, p. 772, 1925 vol 22, pp 482 and 491; 1928). The development of obesity after castration does not always occur when it does it is accompanied by a decrease in both the nitrogenous and non-nitrogenous metabolism. there is little change in the metabolism if obesity fails to develop It is possible that these differences are due to variations in the response of the other internally secretory glands to absence of the testes Injection of prostatic extracts increases the nitrogen output in castrated but not in normal dogs, and a similar result was observed in the rabbit. Injection of testicular extracts decreases the nitrogen metabolism Experiments on thyroidectomised animals indicated that the prostatic extracts acted on the metabolism by stimulating the thyroid gland: whilst the effect of testicular extracts is similar to that produced by injections of insulin, so that part at any rate of the influence of the former is due to the presence of the latter hormone in the extracts, as confirmed by examination of their blood-sugar reducing power

In the last two papers Korenchevsky has examined the influence of lipoid extracts and of watery extracts fractionated at various reactions: atrophy of the secondary sexual organs in rats was not prevented by injecting these extracts, and the effects on the metabolism of rabbits were usually an increase in the nitrogen metabolism, provided that the thyroid gland was present. It is doubtful how far these results can be ascribed to the presence of a specific hormone in the extracts: maintenance of the secondary sexual organs in a functional condition in the castrated animal would appear to be a true index of the presence of a specific principle, and this has not yet been accomplished.

In conclusion, a few words may be said on the subject of rejuvenation. A critical investigation of Voronoff's experiments on the improvement of live-stock has been presented by F. H. A Marshall, F. A E Crew, A Walton, and W. C. Miller (Ministry

Agric. and Fisheries, Board of Agric. for Scotland). The investigators concluded that the methods of experimentation were not sufficiently critical to enable an answer to be given to the question of whether testicular grafting can improve the fertility of old stud bulls or the production of wool by the offspring of grafted rams In any event the economic importance of such experiments for Great Britain is probably only slight. It is necessary to bear in mind that a testicular graft, to give satisfactory rejuvenation, must not only maintain the secondary sexual organs and characteristics in full function and exert the normal influence of the testis upon the cells of the body, but also stimulate the subject's own organ sufficiently to enable it to produce living spermatozoa : the former effect can be produced by secretions from the graft, but only the subject's own testis can render him fertile Testicular grafting is a useful method of investigating scientifically the secretory function of the testis: its usefulness as a practical measure must still be considered not proven

Obituary.

PROF GEORG KASSNER.

DR. GEORG KASSNER, emeritus professor of pharmaceutical chemistry and chemical technology, died at Munster on Mar. 30, 1928, at seventy-one years of age From the *Chemiker-Zeitung* we learn the following particulars of his life. A native of Luben in Silesia, Kassner studied at Basel, Zurich, and Breslau, and received his first appointment in 1884 at Breslau under Prof. Poleck. In 1891 he was appointed professor of pharmaceutical chemistry and chemical technology at the University of Münster, where for thirty-five years he directed the training of students of pharmacy. He also took an active interest in municipal affairs, and served for fifteen years on the Town Council In his teaching Kassner laid stress on the use of volumetric methods of analysis, and his methods were adopted in many other institutes.

The work which Kassner had begun at Breslau led to a method of preparing oxygen from the air by means of calcium plumbate. One of the chief disadvantages of this method was the fact that it involved the use of carbon dioxide, and when Linde's liquid air process was discovered Kassner recognised its superiority. But, being convinced that further progress in the economical production of oxygen from air would be on chemical lines, he set to work to devise improvements, and in 1911 he succeeded in finding an inexpensive method of preparing both oxygen and nitrogen from air by means of plumboxan, a mixture of sodium plumbite and sodium manganate This process works at 400° C, a much lower temperature than was needed for his older process, and, moreover, the use of carbon dioxide was eliminated

During the War, Kassner discovered in the double compound of barium metaplumbate and barium manganate a useful catalyst for the atmospheric oxidation of ammonia to nitric acid at 500° C. In addition to the work on lead compounds, he published numerous papers on other chemical subjects

DR E. F J. LOVE.

THE University of Melbourne has suffered a loss in the death, on Mar 8, of Dr E. F J. Love, formerly senior lecturer in natural philosophy. A brother of Prof. A E. H Love, he was born in Weston-super-Mare in 1861; he became a scholar of St John's College, Cambridge, and, after a short period as lecturer in physics in Birmingham under Prof Poynting, he was appointed to Melbourne in 1888. While he maintained a close interest in all branches of physics, his main interest centred in geodesy and thermodynamics. In 1893 he published an account of a measurement of g at Australian stations, and at the time of his death he was secretary of the geodesy committee of the Australian National Research Council. Dr. Love was president of Section A of the Australasian Association for the Advancement of Science in 1907, when he spoke on the thermodynamics of the voltaic cell, and during his teaching work in the University of Melbourne he came to be recognised as an authority on thermodynamics. Acoustics was another interest, and during the last few years he has applied the results of Sabine to the remedying of some local halls that had been acoustically defective He was president of the Victorian branch of the British Astronomical Association from 1899 until 1903 At the end of 1927 he retired from active teaching duties, and he then presented to the University a valuable collection of scientific periodicals and works on geodesy

WE regret to announce the following deaths

Prof. Henri Andoyer, professor of astronomy at the Sorbonne in Paris since 1903, and an associate of the Royal Astronomical Society, on June 12, aged sixty-six years.

Prof. Franz Keibel, director of the anatomical and biological institute, Berlin, and a member of the Prussian Academy of Sciences, author of the "Normentafeln" of vertebrate development, and with Franklin P. Mall of "Handbuch der Entwicklungsgeschichte der Menschen", on April 27, aged sixty-seven years.

Prof. Charles Moureu, professor of organic chemistry at the Collège de France and an honorary fellow of the Chemical Society, aged sixty-six years.

Mr. Robert Ridgway, member of the National Academy of Sciences, curator of the division of birds in the U.S. National Museum since 1876, who was a past president of the American Ornithological Union and an honorary member of the British Ornithological Union, on Mar. 25, aged seventy-eight years

Dr Charles E de Medicis Sajous, professor of applied endocrinology in the graduate school of medicine of the University of Pennsylvania, and president in 1917 of the American Association for the Study of Internal Secretions, on April 27, aged seventy-six years.

Mr. M. R. Oldfield Thomas, F R S., for many years assistant in charge of Mammalia, British Museum (Natural History), on June 16, aged seventy-one years.

News and Views.

WE have received from Dr W. G. Woolnough, geological adviser to the Australian Commonwealth Government, some comments on the leading article in NATURE of Mar. 2, dealing with the place of biology in school science. This article, while stressing the unfortunate consequences of the neglect of biology in the schools curricula, pointed out that unless biology was approached through the medium of physics and chemistry the discipline of exact and critical thinking that these sciences confer might be seriously weakened. Dr. Woolnough believes that "it is the very inexactness of the 'biological' sciences which trains those habits of observation as opposed to manipulation, and which brings out the faculty of discrimination which is the essential of true scientific research". But this is only true provided the student has already some basis of observational and manipulative training on which to develop his faculty of discrimination; the whole point of the article was to show that physics, chemistry, and mathematics could not be displaced from this service by biology.

THAT this is so is well shown by the actual illustration given by Dr. Woolnough in support of his views. After much experience in teaching microscopical petrology he has found the heuristic method most effective. The meaning of such terms as refractive index, double refraction, cleavage, etc., is demonstrated to the students, who are then encouraged to make their own discoveries, aided only by a simple tabular guide and their text-books. But this method is only effective because the working material can be relied on not to 'play tricks' with the young student. Cleavage and double refraction, for example, are definite physical phenomena: a doubly refracting crystal does not suddenly change its mind and become opaque for a few days, whereas superficially erratic behaviour of this order is a commonplace in biology. Had his duties been connected with biological instead of non-biological instruction—with, say, mycology instead of petrology—he would have been brought up against this essential difference. It is precisely because exact physical science is the foundation of Dr. Woolnough's teaching methods that he is able to use the method at all.

CORNWALL has produced many distinguished engineers and men of science, but none more worthy than Humphry Davy. It was therefore very fitting that Penzance should do honour to her most distinguished citizen, who was born just opposite the spot where his statue now stands, and where the celebration was carried out. At noon on June 8 the mayor and council of Penzance and the following: Sir Humphry Davy Rolleston, Col. R. Humphry Davy and his wife, and R. Davy (descendants of the family); Sir Ambrose Fleming, representing the Royal Institution; Dr. J. Symons (president), E. H. Davison (secretary), and members of the Royal Geological Society of Cornwall; J. C. Tregarthen (president), J. R. Paull (secretary), and members of the Royal Institution of Cornwall; H. Jenner and W. L. Fox (past presidents), E. W. Newton (secretary), and members of the Royal Cornwall Polytechnic Society; W. E. T. Hartley, principal, University College, Exeter, and others met at St. John's Hall, and walked in procession to the statue, where a platform had been erected, and in the presence of many thousands several speeches were made.

THE Mayor of Penzance, Mr. W. G. Goodfellow, said in the course of his remarks: We are met here to-day to do honour to the memory of one of the illustrious sons of this borough. Of the three learned societies of Cornwall responsible for arranging these celebrations, two of the presidents are Penzance men, born near this spot, as also was the case with Sir Humphry Davy himself. Dr. Symons and Mr. Tregarthen then laid a wreath of laurel on the monument. Dr. Symons, speaking on behalf of the three learned societies of Cornwall, said that a former mayor, Dr. Richard Pearce, on the occasion of his laying the foundation stone of the present Market House in 1836, remarked that the site of the assembly would ever be considered as memorable. It was here that the greatest philosopher of the age first devoted himself to that science which rendered his name immortal; "Humphry Davy was born in the house just below, where he resided with his parents until they removed to Varfel, Ludgvan, when he was six years of age". It is somewhat a remarkable coincidence that the laying of this wreath should have devolved upon two who were born within a few yards of his birthplace, and who are now the presidents of two of the Royal societies of Cornwall. Mr. J. C. Tregarthen, speaking on behalf of the scientific societies of Cornwall, thanked the Mayor for the civic welcome and said that Davy's almost last words were: "I have added some little to the quantity of human knowledge, and I have endeavoured to add something to the quantity of human happiness". A public meeting was held in the Pavilion in the afternoon, at which the speakers were Sir Humphry Davy Rolleston, Sir Ambrose Fleming, and others.

MR. R. A. WATSON WATT announced in his Symons Memorial Lecture to the Royal Meteorological Society (see NATURE, April 6, p. 545) that current weather maps were to be broadcast from Daventry (5XX), and a specimen synoptic chart as received by wireless was reproduced in our columns. Arrangements have been completed by the Meteorological Office, Air Ministry, the British Broadcasting Corporation, and Messrs. Wireless Pictures (1928), Ltd., for the experimental issue from Daventry (5XX) of such weather maps by the Fultograph process between 2 o'clock and 2.25 P.M. on Tuesdays and Thursdays, and transmission commenced on June 18. The map will be prepared by the Meteorological Office and is similar in form to those published in the Press. It shows the conditions over the British Isles and the neighbouring sea areas, and is not only of interest to many who receive the official forecasts and like to visualise the conditions on which they are based, but

should also be of great value to those who have sufficient knowledge of the weather to be able to base forecasts for their own locality upon it The great difficulty in the past has always been to get weather maps delivered quickly enough for practical use to be made of them. Wireless transmissions will overcome this difficulty, and though during the experimental period the 7 A M weather map will not be broadcast before 2 P M , should the experiment prove successful it may be possible to arrange for an earlier transmission

THE publication of two volumes of the Annual Report of the Bureau of American Ethnology within a short period of one another emphasises the extent and value to anthropological science generally of the researches which are being carried out under official auspices in the United States. In the interests of research workers in other parts of the world it is to be regretted that publication of these reports is much delayed. Early publication of a record of results is most desirable even if that means postponement of comparative study. In this matter the promptness with which the British Museum has published the results of its investigations in Honduras is worthy of much praise and also emulation by other official institutions. In the present case the forty-second Annual Report, which was the earlier to appear, carries us only to 1925 Much important work has been done since then. The forty-first Report, which has only just appeared, covers the work of five years from 1920 to 1924 Although it must be recognised that the permanent value of these volumes lies in the "Accompanying Papers", in which members of the staff record the result of their investigations, yet the brief introductory reports of the chief, Dr. W J. Fewkes, are of the greatest interest to those in other countries who wish for an authoritative survey of the general trend of investigations in American archæology and ethnology. In the present instance in the years under review there has been a great increase in popular interest in the aborigines, and this has strengthened a movement to preserve as national monuments important ancient sites of aboriginal culture. It is also to be observed that a sense of responsibility towards the Indian is growing, a gratifying if somewhat belated sentiment.

IT is interesting to note how, in the years covered by the forty-first and forty-second Annual Reports of the Bureau of American Ethnology, the area covered by the work of the Bureau is being extended to wider fields. A beginning has been made in examining and attempting to preserve such vestiges of the ancient culture of Alaska as have survived. Within the United States themselves, the southwestern area, not unnaturally in view of its cultural importance, for long almost absorbed the resources of the Bureau. Now, however, attention is being turned to the south-east. To the forty-second Report Mr. John R Swanton contributes two papers dealing with the Creek Indians and one in which he reviews the information relating to the aboriginal culture of the south-east to be found in the writings of the early English, French, and Spanish writers, as well as the material collected by himself The late Mr. William E Meyer, a lifelong student of Indian antiquities and culture, though not a professional archæologist, is the author of a study of Indian trails of the south-east. A paper by the same author on two prehistoric villages in middle Tennessee is included in the forty-first Annual Report. The Gulf area, which falls within this south-eastern zone, is peculiarly important for American ethnology, as the earliest inhabitants appear to have been a brachycephalic type such as is found nowhere else in America A third extension which will be of much moment for the work of the Bureau in the future arises from its responsibility for work in Hawaii. As a result of a preliminary survey of the Hawaiian material, made when the Pan-Pacific Congress was held at Honolulu, it has been pointed out that the study of Hawaiian culture involves an extension to Samoa and other parts of the Pacific—a suggestion which has already borne fruit, for since the date of this report much valuable work has been done by American investigators in the Pacific This emphasises the reflection from which we started, that early publication of these reports is greatly to be desired.

THE Faraday Society is arranging a general discussion on "Molecular Spectra and Molecular Structure", which will be held at the University of Bristol on Tuesday and Wednesday, Sept. 24 and 25 A general introduction to the subject will be given by Prof W. E. Garner and Prof J E Lennard-Jones. The subject will be discussed in three sections, namely, band spectra in the visible and ultra-violet, which will be specially introduced by Prof. O. W Richardson, the Raman effect, to be introduced by Sir C. V. Raman, and infra-red spectra, which will be introduced by Prof. C. Schaefer in respect of solids, Prof. J. Lecomte in respect of liquids, and Sir Robert Robertson in respect of gases Papers have already been promised by Mr. S. Barratt, Prof. G. B. Bonino, Prof J. Cabannes, Prof W E. Curtis, Prof P Daure, Prof I. W. Ellis, Prof. V. Henri, Prof E. Hulthén, Dr R. C Johnson, Prof V. Kondratjew, Prof E F. Barker and Prof C. F Meyer, Dr A. M Taylor, and Mr F. I. G. Rawlins. In addition, contributions are expected from Prof. R T. Birge, Dr H. A Deslandres, Prof. F. Hund, Prof. R. S. Mulliken, and Prof. R. W. Wood.

As in the case of recent successful discussions arranged by the Faraday Society, all the papers will be issued in advance proof, and the authors will be invited to devote a few minutes only to directing attention to points which they deem to merit special discussion, so that there will be adequate time for a lively general discussion. By the kindness of the Council of the University of Bristol, members and visitors will be accommodated at the newly opened Wills Hall. Particulars of arrangements can be obtained from the secretary of the Faraday Society, 13 South Square, Gray's Inn, W.C.1. Cheap railway facilities will also be obtainable for those attending the meeting. In view of the exceptionally large number of guests from abroad who will be attending this meeting, it is expected that there will be a

correspondingly large attendance of British workers. The Society extends a cordial invitation to all those interested, whether they are members of the Society or not, and in particular invites research students to be present.

THE dangers attaching to ignorant treatment and working of different types of land are well known to the practical agriculturist The subject was discussed (*Daily News Bulletin*, Science Service, Washington, D.C) by Mr. Paul Redington, chief of the Bureau of Biological Survey, when speaking at the banquet of the Third New England Forestry Congress held in Hartford, Conn After alluding to the fact that much of their forest land is more profitable for producing wood and game animals, Mr Redington expressed the opinion that in the present era of agricultural depression through over-production it is a mistake to increase the area of farm lands by draining and breaking up of swamps and shallow lakes "Too largely", he said, "in the past such areas have been looked upon as something merely to be drained to get rid of the water and make the land available for the production of farm crops and live stock In many instances this has reclaimed land that was utterly unsuited for such production, and at the same time it has destroyed it for uses to which it might have been more profitably devoted So long as there is more land available than is needed for agricultural and live-stock production, which is the case in the United States, extensive drainage projects are, in my opinion, misdirected effort" From a different viewpoint the caution applies with equal force to Great Britain We are not in the position of having more land available than is required for agricultural purposes; but it is not in doubt that considerable areas of undeveloped lands in the country will not respond to expensive drainage operations and become thereby of value for agricultural purposes The first step in the treatment of much of this land is by way of afforestation Drainage works with the latter object in view are comparatively inexpensive and will not involve the larger scale and excessively costly operations (with probable disaster as their outcome) which are now being announced in some quarters as a panacea for unemployment.

IN the May issue of the *Journal of Chemical Education* C A. Kraus and S T Arnold describe the results of an investigation into the training which chemists should have before entering chemical industry. They visited a number of industrial and research laboratories in the United States and collected representative opinions from research directors and works managers. From a collation of these opinions, it appears that graduates who propose to adopt an industrial career should have a thorough knowledge of general analysis, particularly quantitative, a sound working acquaintance with fundamental organic chemistry, facility in the use of English, and a reading knowledge of foreign languages, especially German Training in industrial chemistry and in engineering was not stressed, but it was felt that the student should have a reasonably good equipment in mathematics and physics, emphasis being laid upon the importance of thermodynamics There was little demand for a knowledge of the latest developments of academic chemistry, but the desirability of a year's post-graduate research was urged by practically everyone Stress was also laid upon personality It would be interesting to know the views of English industrial chemists upon this matter, since a large number—probably the majority—of graduates in chemistry at British universities enter the chemical industries, and it is clearly of great importance to the country as a whole that they should reach their maximum efficiency as quickly as possible Incidentally, the foremost position assigned to analytical chemistry may be commended to the attention of science masters in the schools, where there is a noticeable tendency to cut down analysis to a minimum.

REFERENCE was made in our issue of Dec 17, 1927, p. 890, to the Belgian National Fund for Scientific Research, which was inaugurated at the centenary celebrations held that year of the famous Cockerill Works at Seraing According to the *Times* of June 12, within a year a sum of no less than £640,000 was given by some 1200 subscribers, and grants have been made to 30 engineers and scientific workers to enable them to carry on original investigation under their employers. Subsidies have also been allocated to research students The romantic story of the Cockerill firm, which employs several thousands of workmen, begins with the Lancashire mechanician, William Cockerill (1759–1832), who after some adventures in Russia and Sweden settled in Belgium in 1799 and entered into a contract to supply spinning machines, thus introducing into that country an industry of which England had previously had a monopoly. It was his sons, Charles, James, and John who in 1817 founded the factory at Seraing, John, in 1835, becoming the sole proprietor He died of typhoid fever while on a visit to Russia in 1840, but in 1867 his remains were removed to Belgium. Owing to the German occupation, the centenary of the works could not be celebrated in 1917, but on the one hundred and tenth anniversary of their establishment important gatherings were held, and it was then that the King of Belgium made the appeal for the creation of the National Research Fund.

A PRELIMINARY programme has been issued for the one hundred and tenth annual meeting of the Swiss Society of Natural Sciences The meeting will be held at Davos on Aug. 29–Sept. 1, under the presidency of Dr W. Schibler, and the proceedings will be divided up among seventeen sections The programme includes lectures by Dr. W Morikofer, of Davos, on problems of meteorological radiation research; by G. Bener, of Chur, on mountain road construction and science; by Prof. R Staehelin, of Basle, on the physiology of high altitudes; by Prof. E Guyénot, of Geneva, on the hypothesis of morphological territories in biology; and by Prof. R. Doerr, of Basle, on the submicroscopic forms of life. Excursions to the Swiss National Park, to one of the institutes for the study of the physiology of high

altitudes, to the Davos observatory, and to other places of interest, are being arranged. All correspondence should be addressed to the secretary Dr. W. Mörikofer, Observatoire physico-météorologique, Davos-Platz. The titles of communications for the sectional meetings should be sent in by June 30.

THE Annual Report of the Imperial Institute for 1928 is a record of many useful activities in the investigation of agricultural and mineralogical problems, the answering of inquiries, and the promotion of various educational projects. Among the investigations there may be mentioned the examination of Tasmanian stringybark pulp, which showed its value in the manufacture of artificial silk; tests which prove that Indian hemp is equal to European hemp in its resistance to fresh and salt water; the suitability for brick and tile making of clays from various parts of the British Empire, and the examination of many mineral specimens These are only a few examples of the kind of work which now engages the Imperial Institute, and they show its importance in research into the economic value of various parts of the British Empire.

A DESCRIPTIVE pamphlet on the Hudson Bay Region, with many illustrations and maps, has been issued by the Natural Resources Intelligence Service of the Canadian Government. The forthcoming completion of the Hudson Bay railway to Churchill, in providing a new route to a vast region, revives interest in the resources of this part of Canada After physical and historical introduction, the pamphlet continues with a description of the forests, minerals, water-power, and game. Gold, silver, and copper-zinc ores have been located and in some places are being worked. The pamphlet, which contains no exaggerated claim for this part of Canada, is an interesting example of the way in which lands that were formerly little known were assumed to be of no value, but are now proving relatively attractive and at any rate not unworthy of considerable attention.

THE seventh congress of the Far Eastern Association of Tropical Medicine, held at Calcutta in December 1927, was the subject of an article in NATURE of Mar. 3, 1928. The *Transactions* of the Congress are now in course of publication (Calcutta. Thacker's Press and Directories) in three large volumes, each of approximately 1000 pages, of which the first has already been received. The growth of the work done by successive congresses may be traced by the size of the *Transactions*, which has gradually increased in successive issues, those of the congress held in Hong-Kong in 1912 were contained in a single volume of 399 pages, while those of the sixth congress held in 1925 in Japan required two volumes and 2313 pages. The present volume comprises the proceedings of Sections I. and II.—the subjects of medicine and dermatology, pathology, surgery, ophthalmology, gynæcology and diseases of pregnancy, mental hygiene and psychiatry, radiology, dentistry, State medicine, general and special hygiene, and maternity and child welfare. Eighty-seven papers, many of great interest, with the discussions which followed their reading, are contained in the present volume, which is illustrated by 61 plates, mostly in half-tone. The editor, Lieut.-Col. J. Cunningham, is to be congratulated on the result of his labours. The two volumes still to appear, which will contain the papers on such subjects as plague, cholera, leprosy, tuberculosis, bacteriology, protozoology, malaria, kala-azar, medical entomology, helminthology, diseases of nutrition and deficiency diseases, immunology and chemotherapy, and rabies, promise to be even more interesting than the present one to the general scientific reader.

A NEW volume of that comprehensive work entitled "Nauka Polska" (Polish Science), published by J. Mianowski, Warsaw, for the Institute for the Encouragement of Scientific Works, has recently been issued. This quarto volume of nearly 700 pages is the result of the collaboration of seventy-five leading scientific workers, who have reported upon the means of organising and developing education and research in science subjects in Poland. Much attention has evidently been devoted to a consideration of the immediate and future needs of the scientific institutions in the nation's various centres of learning, but public attention is also directed to the progress already made during the past decade "Nauka Polska" not only includes the natural and physical sciences and their numerous subdivisions, but also gives an account of work in Poland on psychology, criminology, aerodynamics, technology, geography, ethnology, philology, architecture, etc. Interest has hitherto been most concentrated on the applied sciences, such as the technology of the metals. It will be recalled that the president of the country, Prof. I. Moscicki, is himself a distinguished chemist and was formerly director of the Chorzow Fixation of Nitrogen Industry in Polish Silesia. Until recently it was not possible to form an opinion of the extent of the scientific work which was being conducted in Poland since investigators published their results in Russian or German journals. Whilst this is no longer the case, one difficulty remains, namely, the fact that researches appearing in Polish publications only become known to scientific workers abroad through the various abstracting journals.

THE Herbert Spencer lecture delivered at Oxford on May 14, 1929, by Dr. C S. Myers had for its subject "Psychological Conceptions in Other Sciences" (London: Oxford University Press. 2*s*. net) The speaker is thus reversing the conventional practice of interpreting the 'higher' sciences in the language of the 'lower'. There is a growing belief among physicists that it is impossible to predict what an individual atom or electron will do or which of the possible jumps of a quantum will occur next. The psychologist, whose chief preoccupation has been with the individual, even when that individual was recognised as part of a group, has found mechanism everywhere, yet prediction with regard to the individual impossible. Dr. Myers in the lecture inquires how far knowledge of the mental world is helpfully applicable to the material world. He

reviews various problems, such as the distinction between primary and secondary qualities, estimation of weight and appreciation of colour, the intensity of sensations, and shows how, with the development of knowledge, ideas of the 'absolute' have been gradually replaced by those of the 'relative'. Physics also has progressed along a similar path, and in place of the older notions of substance and absoluteness is finding itself occupied more and more with structure and entities in themselves unknowable and unimaginable The lecture is very interesting and suggestive and the point of view original It should prove stimulating to all scientific workers who are interested in the more ultimate problems of knowledge.

THE Huxley Memorial Lecture for 1930 of the Imperial College of Science and Technology will be delivered by Prof. Graham Wallas, emeritus professor of political science in the University of London, on Monday, May 5, 1930, at 5.30 P M

A SMALL earthquake was recorded at Kew Observatory on June 10 The first tremors reached the Observatory at 23 h 7 m. 51 s G M T The shock originated under the Arctic Ocean about 200 miles from the Norwegian coast and about 250 miles from Tromso, near latitude 71° N., longitude 9° E. A large earthquake was recorded at the Observatory on June 17. The first tremors arrived at 23 h. 7 m. 37 s. G.M.T., and the epicentre is estimated to have been about 12,000 miles away.

THE Albert Medal of the Royal Society of Arts for the current year has been awarded by the Council, with the approval of the president, the Duke of Connaught, to Sir Alfred Ewing, Principal and Vice-Chancellor of the University of Edinburgh, "for his work on magnetism and his services to technical education". The Medal was founded in 1863 as a memorial to Prince Albert, and is awarded each year "for distinguished merit in promoting arts, manufactures, and commerce".

AT a meeting of the executive committee of the Imperial Botanical Conference (1924), held in London on Jan. 18 last, it was decided to arrange a short Imperial Botanical Conference to be held immediately before the International Botanical Congress in 1930 The Imperial Botanical Conference, which it is intended should last only one day, will meet in London on Friday, Aug. 15, 1930, at the Imperial College of Science and Technology, South Kensington, S.W.7. The agenda before the conference will be purely of a business nature. The proposal to hold a further Imperial Botanical Conference in 1935, on lines similar to that held in 1924, will be discussed, and, if necessary, the appropriate organisation for convening the conference will be arranged. Reports of the committees which have dealt with the resolutions of the 1924 conference will be received.

THE January–March issue of *The World's Health* (Vol. 10, No. 1), the organ of the League of Red Cross Societies, is presented to readers in quarterly form as an experiment. A survey of the present position of leprosy is commenced in this number, with articles on leprosy in Japan, Siam, and Columbia.

THE Medical Directory Guide to "British Spas and Climatic Health Resorts" for 1929, edited by Dr R. Fortescue Fox, has been issued by Messrs. J. and A. Churchill, 40 Gloucester Place, W 1, price 1*s*. Information is given of the medicinal waters and spas of Great Britain and of marine and inland health resorts, with the clinical indications which may influence the choice of a particular spa or resort for a patient.

THE monthly publication of the Air Ministry known as the *Marine Observer* fills an important place in meteorological research with its copious notes supplied by observers at sea on various phenomena, and its abundant charts and illustrations A feature of recent numbers has been the general articles compiled at the Air Ministry on various aspects of marine meteorology. These are valuable chapters, not only to sailors, but also to students The May issue contains a long article on the formation, occurrence, and prediction of fog, and another article on the local winds of the Mediterranean and Black Seas. The April number had an account, illustrated by many charts, of the distribution of ice in the western North Atlantic, with special reference to the work of the United States *Marion* expedition in Davis Strait in the summer of 1928.

WE have recently received copies of a number of *Leaflets* issued by the Ministry of Agriculture and Fisheries, which have been rewritten in order to bring them up-to-date with advances in knowledge. The *Leaflets* deal with various pests affecting agriculture and serve to keep the farmer and grower advised as to the best practical measures for controlling such enemies Apple capsids are of particular interest because they have only become serious pests during the present century, and a good deal of research has been, and is still being, concentrated upon them. The latest *Leaflet* on the subject was rewritten in August 1928 and revised in January 1929 in order to bring to public notice the results of recent practical researches Other *Leaflets* deal with onion fly, slugs and snails, insecticides, and kindred subjects.

A CATALOGUE of books on chemistry and chemical technology has been issued by Messrs H. K. Lewis and Co., Ltd , 136 Gower Street and 24 Gower Place, W.C.1. It contains particulars of a large number of books arranged under a very convenient system of classification.

MESSRS. Francis Edwards, Ltd., 83 High Street, Marylebone, W.1, have just circulated a handsome illustrated catalogue (New series, No. 2) of some 1000 books, pamphlets, and engravings relating to North America, which should be of interest and value to geographers and historians. The catalogue contains facsimile reproductions of the title-pages of many of the works listed , also bibliographic notes on some of the volumes.

MESSRS. C. BAKER, 244 High Holborn, London, W.C.1, have sent us a copy of the new issue of their classified list of second-hand scientific instruments (No 94). This list is now sent out twice a year only. As usual,

the list contains a comprehensive selection of microscopes and microscope accessories, and there is a large section on surveying instruments, which, it may be noted, are let out on hire. Arrangements can also be made for hiring other apparatus. Other sections deal with projectors, telescopes of various kinds, and various physical apparatus.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A junior assistant at the Forest Products Research Laboratory, Princes Risborough—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (June 25) A geologist in the Geological Survey Office, Department of Industry and Commerce, Irish Free State—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (June 26) A junior lecturer in the department of pathology of the University of Liverpool—The Registrar, The University, Liverpool (June 27). A head of the school of engineering at The Polytechnic, Regent Street—The Director of Education, The Polytechnic, Regent Street, W 1 (June 28). An assistant lecturer in machine drawing and design in the engineering department of the County Technical College and School of Art, Newark —The Secretary, County Technical College and School of Art, Newark (June 29) A number of junior assistants at the National Physical Laboratory—The Director, National Physical Laboratory, Teddington (June 29) A wireless engineer under the Government of Nigeria for the Posts and Telegraphs Department—The Crown Agents for the Colonies, 4 Millbank, S W 1 (quoting M/1267). An assistant lecturer in the department of biology of the Huddersfield Technical College—The Director of Education, Education Offices, Huddersfield A lecturer in chemistry and physics in the school of pharmacy of the Merchant Venturers' Technical College, Bristol—The Superintendent, Merchant Venturers' Technical College, Bristol. A lecturer in building and civil engineering at the Royal Technical College, Salford—The Secretary for Education, Education Office, Salford. An assistant in the mechanical engineering laboratory of University College, London—The Secretary, University College, Gower Street, W C.1.

Our Astronomical Column.

THE TOTAL SOLAR ECLIPSE OF MAY 9.—Dr. Baade, of Bergedorf Observatory, was stationed at Sogod in the Philippine island of Cebu. He reports in *Astr. Nach*, 5630, that cirrostratus clouds interfered with the photography of the outer corona, but very successful plates of the inner corona were obtained, which show its structure clearly. Rev T E R. Phillips exhibited at the meeting of the Royal Astronomical Society on June 14 some prints of the corona obtained by Dr R Waterfield at Iloilo, Philippines. The extension shown on these was about one solar radius, but the negatives showed it a good deal further. There appeared to be much less extension of the corona near the sun's poles than elsewhere, this is a familiar feature at sunspot minimum but less common near maximum.

THE FUTURE OF THE SUN.—The above is the title of the first of three articles by Dr. Harold Jeffreys on geology and the related sciences to appear in the *Realist*, the first is in the June issue Dr Jeffreys notes that the hypothesis of the contraction of a great rotating mass of gas with an accompanying shedding of equatorial rings (originally propounded by Laplace and developed by Roche, Helmholtz, Kelvin, Lane) was held by many astronomers up to the beginning of this century; it was gradually discarded on two grounds; it gave an insufficient time-scale, and there were grave dynamical difficulties in connexion with the moments of momentum of the sun and planets

Part of the contraction hypothesis was held until the year 1924; the dwarf stars were supposed to be those that had contracted beyond the point of continuing to have a purely gaseous constitution, so that by Lane's law their temperature would now decline Eddington then concluded by theoretical reasoning that the rate of radiation of energy should depend almost wholly on the mass of the star. On plotting the stars of known mass he found that both giants and dwarfs lay on the same curve, and that the state of perfect gas continued much longer than was previously supposed, owing to the stripping off of the outer rings of electrons in the stellar atoms A strong confirmation of the correctness of this conclusion was afforded by the demonstration of the great density of the companion of Sirius, which at the same time gave a proof of the shift of spectrum lines in a strong gravitational field which Einstein had predicted.

The energy of stellar radiation is now ascribed to the conversion of the stellar matter into light and heat; the details of the process are still obscure, but it is conjectured that colliding protons and electrons may cease to exist as matter, becoming simply radiation The energy in the atom is so great that the possible life of the stars is extended from a few million years to many millions of millions. The former contradiction between the estimated past duration of the sun and that of the earth has thus been completely removed.

THE OPACITY OF STELLAR ATMOSPHERES.—The Bakerian Lecture at the Royal Society was delivered on June 6 by Prof. E. A. Milne on the subject of the opacity of stellar atmospheres He notes that the problem involves the study of the property of layers of gas, given the amount of the energy flux, and the intensity of the gravitational field it is further necessary to consider the effect of changing temperature in comparing the different spectral types, and the effect of absolute magnitude in comparing different stars of the same spectral type It is pointed out that there is no sharp boundary between photosphere and reversing layer, but that one merges into the other The solution of the problem depends largely on study of the contours of spectral lines, that is, on the determination of their intensities at different distances from the centre of the lines. The method is applied to a zinc triplet in the spectra of Capella (bright component) and the sun, which are taken as a typical giant and dwarf of type $G0$ The absorption coefficient κ is found to be 300 for the sun and 60 for Capella Miss Payne found $\kappa = 150$ for A-type stars, which is in satisfactory accordance. Once κ is known the number of atoms above the photosphere can be calculated on certain assumptions for the different elements. It is shown that the dependence of κ on the electron pressure P is confirmed by the fact that observation indicates an effect depending on absolute magnitude for stars both at low and high temperatures.

Research Items

SEX AND INFANT MORTALITY.—The difference in the mortality of the sexes during infancy is one of the most significant indications available of the constitutional factor in disease. During infancy the environment is uniform for both sexes, so that variation in the mortality rate between males and females may be attributed to variation in the sex response to environmental factors From this point of view, Dr Harry Bakwin has analysed the infant mortality throughout the United States registration area for the ten-year period 1915–1924 inclusive (*Human Biology*, vol 1, No. 1, 1929). Male mortality far exceeded female under one year of age, to every 100 female deaths there were 130 to 134 deaths of males. The difference is not confined to the first year, but is most marked at birth and decreases with age until in the fourth year the death-rate is about equal for the two sexes. But there are two exceptions to the gradual decrease · on the third day of life the mortality difference between the sexes is more marked than at birth, and it is also more marked during the second month than during the first. Since 1900 there has been a fall in infant mortality, but it would appear that relatively more females than males have benefited, for coincident with the common fall there has been a rise in the sex mortality ratio There are seasonal differences in the ratio, as well as regional differences, England, Wales, and Scotland having a high ratio, whereas it is low in Italy, Japan, Jamaica, and Spain In rural communities, moreover, the ratio is lower than in city areas.

A PRE-ISLAMIC GOD OF ARABIA.—In the *Indian Antiquary* for May, Ch. Muhammed Ismail figures and describes an image of the god Wadd sculptured on a stone now in the Prince of Wales's Museum of Western India and formerly in the possession of the Bombay branch of the Royal Asiatic Society. The importance of this image is that out of a large number of Arabian sculptures and stones with inscriptions mentioning the god Wadd, this is the only one of which the words purport to say that it is the image of the god Wadd. Owing to a misreading, a decipherment by James Bird in 1844 failed to identify it Wadd was the most important of the pre-Islamic gods of Arabia, that is, of the peace-loving and commercial citizens of Himyar and Saba, who differed widely from the wild Bedouin. All ancient Arabs wore talismans bearing his name, and temples were dedicated to him as the god of love and happiness. His image has been described by an Arab commentator as that of a tall man wearing a loin cloth with another cloth over it, a sword hanging round his neck, and with a bow and a quiver, in front of him a lance with a flag attached to it. The present figure differs. The god is shown as a short man wearing a kilt. On his head is a close-fitting cap with a long tassel which seems to represent a strand of hair Bedouins who come to Aden from the hinterland still shave the lower parts of the head, but keep a tuft or sometimes a long strand of hair on the crown The author comments on the neglect of Arabian antiquities by the Indian Government in Aden and its hinterland, which is under its jurisdiction, but notes that, stimulated by Sir John Marshall's interest in field work, the Aden Historical Society is taking up this important subject

ADAPTATIONS OF THE PELVIS IN MARSUPIALS.—The marsupials show so wide a range of habits that a comparative study of the pelvis in relation to function has, in the hands of Herbert Oliver Elftman, afforded some clear evidences of special adaptation (*Bull. Amer Mus Nat Hist.*, March 1929). Much of the adaptation is associated with locomotion. Thus in arboreal forms there are largely increased muscles of adduction and a more open acetabulum allowing greater freedom of motion of the femur. Leaping forms, with their exaggerated hind limbs, require an elongated post-acetabular portion of the pelvis to provide leverage for the hamstrings, the ilium has an outward flare, and there is a large ilio-sacral angle. Fossorial adaptation depends on the particular method of digging employed by the animal, but in general the ischium is long, the iliacus attains great size and is thus partly responsible for the broadness of the ilium The shape of the pelvis, however, is also associated with other than locomotor factors The gross form is determined by its relation to the viscera Its width is influenced by the width of the trunk. The size of the sacro-iliac angle and the position of the sacro-iliac joint are conditioned by the size of the erector spinæ muscle and the necessity for an adequate pelvic outlet. The marsupial bones assist the abdominal musculature in the support of the viscera and protect the pouch from distortion during the contraction of these muscles

DIFFERENTIATION *IN VITRO* OF CARTILAGE AND BONE—Dr. Honor B. Fell (*Archiv f. exp. Zellforschung*, 7, 1928) records the results of observations on the differentiation *in vitro* of cartilage and bone. Cultures of embryonic limb-cartilage from 8-day fowl embryos were made by the ordinary coverslip technique. The explanted limb-cartilage enlarged greatly during cultivation, and in several specimens differentiated into epiphysial and diaphysial regions. After 10-12 weeks' growth *in vitro*, a proportion of the explants were in a healthy condition. Cultures of undifferentiated limb-bud mesenchyme from 3-day fowl embryos exhibited chrondro-genesis although the tissue was spreading over the surface of the coverslip. Cartilage thus formed *in vitro* sometimes remained in a healthy state during three months' cultivation but underwent no differentiation into epiphysial and diaphysial regions. After 3-4 weeks' cultivation, ossification was observed in several cultures and the progress of bone deposition followed in the living explants

INTERRELATIONSHIPS OF THE ECHINODERMATA.—An exhaustive discussion of the major systematics of Echinodermata, based on anatomical, embryological, and palæontological evidence, is offered by Prof. D. M Fedotov, of the Russian Academy of Sciences (*Travaux du laboratoire zoologique et de la Station biologique de Sébastopol* , Série 2, No. 12, Leningrad, 1928). Pelmatozoa are regarded by the author as the group which has given rise to other Echinodermata. The sea-lilies are derived by him from Cystoidea, while a discussion of the anatomical, embryological, and palæontological evidence on sea-urchins leads him to the conclusion that this group stands quite isolated amongst other classes of the Eleutherozoa, there being no definite grounds for suggesting a relationship between sea-urchins, star-fishes, and holothurians , the origin of sea-urchins was probably in the Cystoidea Diploporita Star-fishes and ophiurs the author believes to have originated from the Edrioasteroidea, though there is no direct evidence in favour of this view. Holothurians are an exceedingly ancient group, dating back perhaps to Palæozoic times, and originated independently from sea-urchins, star-fishes, and ophiurs, but still must be considered as belonging to the Eleutherozoa.

Aliens in the Flora of Victoria.—In an interesting note on the naturalised aliens in the flora of Victoria (*Proc. R. Soc. Victoria*, 41; 1928) Prof. A. J. Ewart states that in 1909 the number of aliens recorded was 363 and in 1928, 461. This rate of increase, slightly more than five per year, has been maintained with remarkable uniformity for the past sixty years. The aliens include the clovers, trefoils, medicks, most of the more valuable pasture grasses, and some garden plants that have run wild. Less than a hundred of the aliens are serious weeds, and few of them so serious a menace as the native bracken on newly cleared forest land. The transport of fodder is probably responsible for the relatively high proportion of aliens contributed by South Africa, which include some of the worst weeds. Prof. Ewart considers that owing to the competition of imported aliens and the pressure of settlement, probably less than half of the original flora (about 3000 species) will survive within fifty years, and many originally widespread plants will be confined to special localities. Were it not for the disturbing factors introduced by man, the spread of the aliens might have been used as a test of Willis's age and area hypothesis. Among the interesting cases cited are: the evening primrose (1887) has covered less ground than the foxglove (1917), the musk weed, *Myagrum perfoliatum* (1916), has become more abundant than the horehound, *Marrubium vulgare* (1870), and the stinkwort, *Inula graveolens* (1893), rapidly overtook the stinkweed *Gilia squarrosa* (1887), both in area and abundance. Even taking species of the same genus, it appears that the time factor is of far less importance in determining the area covered by a species than its suitability to new habitats, its means of distribution, its aggressiveness, and its resistance to foes and injurious agencies. "It seems probable that the age of a species is one of the least important of the factors governing its distribution, and that in only few cases can a relation be traced between the age of species and the area they cover at the present day."

Japanese Hepatics.—The first part of what should prove an important series of papers upon the Hepaticæ of Japan, by Yoshiwo Horikawa, has appeared in the *Science Reports* of the Tôhoku Imperial University, vol. 4, No. 1, series 4. The author points out that more than 500 species are already reported for Japan, of which no less than 65 per cent are endemic. In the present contribution, species of two very interesting genera are described, *Makinoa* and *Schiffneria*. In the case of *Makinoa*, it is interesting to note that the constriction of the thallus, at the point where the sexual organs are developed at the close of the season, enables the different annual increments of growth to be distinguished. In this way six or seven years' growth contributions can sometimes be separated in the same specimen. Field observations of this kind upon the age of patches of liverwort seen growing in Nature are not very common.

The Karakoram Range.—The *Records of the Survey of India*, vol. 22, contains Major K. Mason's account of his explorations in 1926 in the Shaksgam and Upper Yarkand valleys and the Aghil Ranges, with a map on a scale of 1 inch to 4 miles. The report contains a full illustrated account of his travels and a number of appendices on geology, natural history, etc. In discussing the nomenclature of the area, Major Mason points out that the term in general use, Karakoram Range, is a misnomer and that it means literally 'black gravel', and was first applied to the high pass on the route between India and Yarkand. From this pass the term came to be applied to the iciest range of mountains outside polar regions, on which the actual pass does not lie. Accepting the usage, however inappropriate it may be, Major Mason proposes to use the term Karakoram-Himalayas to the whole mountainous area and to distinguish within it three main ranges. Of these the southern he proposes to call the Kailas-Karakoram, the second he terms the Mustagh-Karakoram, and the most northerly the Aghil-Karakoram. To the north-east of this last range lies the Aghil 'Red' Range, which, however, Major Mason was unable to visit. The merits of this nomenclature are discussed at length in the report.

Oil Well $1\frac{1}{2}$ Miles Deep.—Some idea of the astonishing progress of petroleum production-engineering methods is obtainable from a record set up by an oil company operating in West Texas, U.S.A., which succeeded in drilling a successful oilwell to a depth of 8523 ft. below surface. Not only does this represent a wonderful engineering feat, but at one period a measured production of 1125 barrels of oil, and an estimated production of some 12,500,000 cubic ft. of gas, indicate the discovery of pools of no mean consequence. The well formed part of the deep test programme at Big Lake oilfield, and was brought in towards the end of last year. In this region of Texas, known as 'West Texas', a thick Permian limestone, marl, and anhydrite series is exploited principally, but the depth of this particular well leads to the inference that Pennsylvanian beds (Upper Carboniferous) have been penetrated. It is noteworthy that of the 8523 ft. drilled, 2339 ft. represents 'open hole,' $5\frac{3}{16}$ inch casing being set at 6184 ft. There is no reason why drilling should not be carried deeper so far as these data go, but the very high rock-pressure at such depths would tend to exert a controlling influence, while the natural flow of oil and gas in the quantities stated implies similarly high fluid pressure. The temperature of the oil (flowing) was 49° F. The question has often been raised concerning the economic depth of ordinary drilling, attempts having been made to state a maximum beyond which cost of drilling and control would outweigh values yielded by the oil obtained; where pumping costs have to be added, the problem is further complicated. It would seem, however, that deep well drilling is an accepted policy to-day, and if in the future (when oil prices appreciate) the location of deeply buried pools, in fields already exploited for their shallower production, becomes a matter of necessity, there is little doubt that this record will be broken, if it has not already been in the case of other previously projected deep wells.

Einstein's Unified Field Theory.—Mr. G. C. McVittie, in the June issue of the *Proceedings of the Royal Society* (No. A, 794), has provided a supplement to Einstein's somewhat abstract account of the new theory by showing in detail how it can be applied to a simple case. For an electrostatic field uniform in direction and nearly constant in magnitude, but with a slight exponential change of strength as we go along the field, it is possible to obtain exact solutions of the gravitational and electromagnetic equations of the older general relativity theory. These solutions are then substituted in the corresponding equations of the new unified theory. As a result it is found that the new equations are satisfied to the first order but not to higher orders. This shows clearly to what extent Einstein's new equations differ from his old ones. It will be recalled that in a letter to Nature of May 4, p. 678, Prof. Levi-Civita outlined a modification of Einstein's new theory, with the object of obtaining exactly, and not merely to the first order, the older equations on a unified basis. Mr. McVittie would perform a useful service if he would exemplify Levi-

Civita's theory by applying it to the simple case mentioned above

RADIO-INTENSITY MEASURING APPARATUS.—The utility of high frequency radio transmission systems and their extending use has created a demand for an instrument capable of measuring the strength of the magnetic field at any point. J. Hollingworth and R. Naismith read a paper on May 1 to the Wireless Section of the Institution of Electrical Engineers describing a portable apparatus suitable for measuring the absolute strength of the field produced by these currents. An instrument suitable for measurements of this kind can rarely be made by merely altering the electric constants of apparatus suitable for low frequencies. Resistance, capacity, and inductance are no longer constants at high frequencies. The set consists of a detector valve and a control valve. One stage of audio-frequency amplification follows the detector, and a two terminal thermionic valve allows a galvanometer to be used for the signal comparison. A separate heterodyne is used to obtain the audio-frequency. The instrument is capable of measuring the intensity of the magnetic field over a radio band of 5 to 12 megacycles per second. Without batteries it weighs about sixty pounds, and so can be carried in a light car. The authors use an aerial connected to one end of a high resistance, the other end being earthed. The discussion of high frequency measurement, aerial effective height, and wave attenuation all come into the problem. The method adopted, therefore, is to subject the instrument to searching tests for internal self-consistency and then test it out of doors on local transmissions. The results enable the experimenter to determine whether the instrument is reasonably accurate or not. Experimental results are given showing the kind of accuracy obtainable. The work carried out by the authors is part of the programme of the Radio Research Board.

BORIC ACIDS.—Various compounds of boric anhydride with water in different proportions have been described, but the only two boric acids definitely known in the solid state were orthoboric acid, B_2O_3, $3H_2O$, and metaboric acid, B_2O_3, H_2O. By means of vapour pressure determinations in the series B_2O_3–H_2O and measurements of the weights of water lost in passing from one part of the system to another, L. F. Gilbert and M. Levi have been able to show that probably there are eight compounds of the type nB_2O_3, H_2O, where $n = 1, 2, 3 \ldots 8$. This work is described in the *Journal of the Chemical Society* for March, and an approximate value for the heat of hydration of boric anhydride to orthoboric acid is given. This value differs considerably from previous ones, which are thought to be inaccurate.

EXPERIMENTS WITH CAREFULLY DRIED SUBSTANCES.—The *Proceedings and Transactions of the Nova Scotian Institute of Science*, vol. 17, Part 2, contains an account by D. McIntosh of attempts made to prepare carefully dried substances by employing low temperatures. A mixture of carbon monoxide and oxygen may be dried by cooling in a solid carbon dioxide–ether mixture, as was shown by Girvan, and after being kept in the freezing mixture for some hours cannot be exploded by an electric spark. The gas explodes, however, at about $-50°$, when there is about 1 molecule of water present in 40,000 molecules of gas. A similarly treated mixture of nitrous oxide and carbon monoxide always explodes at $-80°$. Other experiments on intensive drying by cooling were not successful, probably on account of the difficulty of removing the water film from the glass surface of the apparatus. Thus, the reaction between hydrobromic acid and ammonia could not be inhibited, although the vapour pressure of the water was reduced to one-thousandth of a millimetre.

NON-EXISTENCE OF ISOMERISM AMONG THE DIALKYLTELLURONIUM DIHALIDES.—Two forms of dimethyltelluronium dihalides were obtained by Vernon and from them two distinct bases, and he accordingly postulated the existence of two series (α and β) of isomeric compounds. He concluded that the tellurium atom had a planar distribution of valencies and suggested formulæ of the type

$$\begin{matrix} I \\ Me \end{matrix} \!\!> Te < \!\! \begin{matrix} Me \\ I \end{matrix} \qquad \text{and} \qquad \begin{matrix} Me \\ Me \end{matrix} \!\!> Te < \!\! \begin{matrix} I \\ I \end{matrix}$$

(α-di-iodide, red) (β-di-iodide, green)

More recently this isomerism has been explained by assuming, from the electronic point of view, that the halogen–tellurium linkages are non-equivalent (see NATURE, April 6, p. 547). In the *Journal of the Chemical Society* for March, H. D. K. Drew gives an account of a re-examination of the dimethyltelluronium di-iodides and dibromides, and the two bases. He concludes that the members of the β-series are not isomeric with the α-compounds. The α-compounds appear to be of normal type, are in general non-polar, and the tellurium atom in them probably has a tetrahedral distribution of valencies. The β-compounds are complex substances resembling salts, but having the same empirical formulæ as the members of the series.

PRESERVATION OF TIMBER.—At the Glasgow meeting of the British Association, a paper was read by Prof. Percy Groom on the "Antiseptic Preservation of Timber" (published in *Empire Forestry Journal*, vol. 7, No. 2, 1928). In his paper, Prof. Groom correctly states that the antiseptic preservation of timber is "usually regarded as merely a means of decreasing the damage done to timber by fungi (and insects), but when properly applied it can result in a positive increase of the available supplies of commercial timbers and thus be equivalent, in effect, to increase of production, and may thereby become closely linked with forestry." The author deals briefly with the losses incurred in the British Empire by decay to timber due to want of adequate preservation and the increased supplies which would result from a better economic utilisation of the available amounts. Such questions have received a great deal of attention at the Research Institute at Dehra Dun, where the first commencement in this line of research in the British Empire was made. Prof. Groom deals with his subject in a highly informative manner, and his paper should be studied by all interested in timber and its utilisation. What, from the practical utility point of view, may be considered a side issue but one of considerable scientific interest, is the author's reference to the interaction of fungi and insects in the destruction of timber, a line of research which promises to be of considerable interest. Prof. Groom's theme did not include this study, but it is alluded to as follows: "The destruction of timber by fungi that cause rot and by insects that burrow into wood may be lessened by a *septic sanitation*, that is to say, by the adoption of measures designed to decrease the production of spores or eggs and to render the external conditions unfavourable to the activity of these organisms". Prof. Groom states that a combination of sanitation and antiseptic treatment gives the best economic results, but his paper is confined to the latter and omits a consideration of insects. His remarks on this subject are of interest.

The South-Eastern Union of Scientific Societies.

CONGRESS AT BRIGHTON.

THE thirty-fourth annual congress of the South-Eastern Union of Scientific Societies was held at Brighton on June 5–8, Sir Arthur Keith occupying the presidential chair in succession to Sir Martin Conway

In his address Sir Arthur took as his subject "The Pre-Roman Inhabitants of Southern England." His endeavour was to trace the people of southern England from the coming of the Beaker folk about the beginning of the second millennium B.C. to the time of the arrival of the Romans The remains of the Beaker folk that have been found with the aid of the pick and shovel have possibly traced that race up to about a thousand years B C., and going backward from Roman times, the folk that Sir Arthur called the 'pit-diggers' have possibly been traced back to 600 years B.C Between these two dates there is a wide interval of which we seem to have no records, and it is this interval that archæologists are endeavouring to fill in Southern Englishmen of pre-Roman times have been disinterred from time to time from the Downs of chalk, which show that they all had certain well-defined common cranial characteristics, and they all have affinity to the Beaker folk who began to invade England from central and north-western Europe some 2000 years before the Christian era.

From the remains that have been found at Blackpatch, near Worthing, it is possible to infer what was the mode of life of these folk. These early Downsmen grew their corn and ground it. They domesticated certain cattle, such as the ox, the sheep, and the pig, and were no longer purely hunters They had looms. The red deer they hunted, and used the antlers as effective mining tools They fabricated flint implements of the same patterns as those from the neighbouring mines of Cissbury

Speaking of the finds of Beaker folk in the neighbourhood of Brighton, Sir Arthur first of all referred to the skeleton of a woman who had been laid to rest in a grave that was cut into when a trench was made for carrying a cable to a golfing club-house on the east of Brighton. The body was laid on its side with the limbs folded on the body There was also here the crouched skeleton of a child some two months old The oval pit in which they had been laid had been completed by covering it with a layer of flint cobbles. Unfortunately there was no grave furniture, no coin, shard, metal, or ornament to show the date at which the woman and child "ceased to breathe the fresh air of the South Downs". Although her skull was of the long type, there were certain features that showed affinity to the Beaker type, a type that is known by its flat vertical occiput, its strong face with rugged features, the eyebrows being usually very prominent and the forehead receding. The type is still frequently seen in England, and it was stated that men of the type are often leaders in communities, Darwin himself reproducing its features.

There appear to be two circumstances which give a clue to the identification of the Beaker people, the crouched position in which they are buried, and the covering of the grave with flint-nodules. Another burial was uncovered in north Brighton in which a woman was buried in a similar position, and although she was long-headed there were traces of Beaker ancestry. She is known as the Maycroft skeleton. Another crouched burial was laid bare at Moulscombe pit, to the north of Brighton, where a male counterpart of the Beaker woman was found. Another burial was discovered when the Ditchling Road was extended to the north, when a male skeleton was disinterred, but his skull was somewhat wider and his face shorter than the Moulscombe man In this case a beaker was found, of the kind used in England in the early part of the second millennium B C, and with it was a barbed flint arrow-head under the skull. Several other graves have been found of a similar nature

Sir Arthur then referred to the ancient flint-mines of Blackpatch and the barrows nearby, whence the skeletons proved to be the same folk as the Brighton people. One proved to have had a remarkable head. It was not the typical Beaker head, for it was both long and wide, being 195 mm. by 155 mm, and it has been thought that it represented a cross between long-headed and round-headed stocks. The graves were destitute of grave furniture, and the men were probably the miners who dug the flint-mines close at hand. A crouched burial of a man with all the characters of the Beaker breed was taken from a barrow on the heights above St. Catherine's Point in the Isle of Wight On the Downs at Nunwell, 12 miles to the north, a skeleton was found in 1881, and the contents of this grave are preserved in the Carisbrooke Museum. With it was buried a lugged pot-like vase, which was thought by Mr. Crawford to have been fabricated in the upper valley of the Rhine, possibly towards the end of neolithic times. The trail of the Beaker-men has been traced through Belgium into England and along the Kentish Downs, and in all cases the resemblance is great Sir Arthur raised the question as to whether the Beaker folk practised child-sacrifice It may be that by coincidence a child died at the same time as the adult with which it was buried, but in quite a number of cases a child was buried with the adult, and this has been found to have been the case at Brighton, on Dunstable Down, in Belgium, and at Worbarrow. Did the Beaker people sacrifice children to give youth to their dead, or was an adult sacrificed to guard the child in the realms to which it had gone? The Beaker blood appears to have been swamped as time went on by that of the ancient natives of England

Mr. Hadrian Allcroft, in addressing the Archæological Section, asked the question as to what was the earliest church, and adduced evidence to show that a church was at first an open-air enclosure, and was not a building at all It was really a burial-place, and a walled-in church was later than the burial-ground in which it stood The Scotish Christianity from Ireland was introduced after the withdrawal of the Romans, and for many centuries looked with disfavour upon any church building of any kind The circular place of burial would enclose a few beehive-huts for the monks, but no reference can be found that in the earliest days there was any place for united worship. A Christian must be buried before the enclosure could become consecrated ground, and if Nature failed to provide this, the early Christians obtained a voluntary sacrifice of a human life. In the case of the founding of the monastery at Iona St Oran volunteered to go to heaven, and was buried on the spot selected for the monastery.

The excavations at Blackpatch, near Worthing, made by Mr. J. H Pull and Mr C E Sainsbury, were described by the former. The position of this prehistoric site is on the borders of an old road running along a spur of the Downs 2¼ miles west of Findon, at between 300 and 400 feet, O D. Here was found a mine-field containing a closely grouped series of pits sunk through the chalk until a seam of good flaking flint was reached in the zone of *Actinocamax quadratus*. Many of the shafts were cleared

and low horizontal galleries were found at their base radiating therefrom. Close at hand were open-air hearths, sunken hut floors, and a series of round barrows, and these barrows have yielded valuable evidence of the Beaker-men who excavated the flint.

Following the address by Mr. A D Cotton, of Kew Gardens, on "The Importance of the Study of Systematic Botany", a paper was read by Dr Geo Morgan on wood-nodules on trees, in which he made a clear distinction between sphæroblasts, or hard knobs of wood existing independently of the inside wood of a tree, and burrs or irregular excrescences from the layers of the wood. Sphæroblasts or woody tumours appear to be in the vegetable kingdom a parallel to the tumours in the animal kingdom known as dermoids

Dr G. P Bidder took "Death" as the subject of his presidential address to the Zoological Section He held that death was biologically a new thing relatively, and that senescence and natural death were not necessary attributes of life. There is no such quality of protoplasm as inherent or intrinsic senescence That part of a living body that is not converted into protected spores, gemmules, or eggs is the body that undergoes the process of natural death There is reason to believe that the female plaice and certain anemones do not die, except by accident

The distribution of certain Sussex birds and insects was dealt with by Mr. A F. Griffiths. Mr. Reginald Smith gave a public lecture on "Early British Art", and showed that before the Romans came over, the Britons had achieved a decorative art of the highest order It had its origin in classical art, chiefly of the Greeks of the age of Pericles, moulded by Roman influence later The artistic but warlike Celts had made a Greek settlement on the Rhine about 440 B.C., and as at this time this country was called Britain, it was perfectly correct to speak of Celtic art in relation to British discoveries round about that period.

In the Geological Section, Mr Henry Dewey gave an address on "The Denudation of the Weald", and Mr. Edward A Martin read a paper on "The Brighton Pleistocene Cliff-Formation" The presidential address to the Regional Survey Section was read on behalf of Prof H J. Fleure, and dealt with various aspects of regional work, and this was followed by a paper by Mr David Edwards, the Brighton Surveyor, on "Town and Regional Planning".

The Congress included a reception by the Mayor, Alderman H J. Galliers, and a number of excursions were made to places of interest in the county.

The Strangeways Research Laboratory, Cambridge.

THE trustees of the Strangeways Research Laboratory, Cambridge (Sir Humphry Rolleston, Prof. H R Dean, Prof Malcolm Donaldson, and Sir Charles J. Martin), have issued an attractive little pamphlet setting out briefly the history of this remarkable institution Beginning in 1907 in a small house as a research hospital with three beds for the study of rheumatoid arthritis, it has gradually developed into a research institute devoted entirely to the study of tissue culture both in its general biological and its more strictly medical aspects Though still small and not too well endowed financially, it has now taken a leading place among the research laboratories. This remarkable achievement has been brought about through the lovable personality, the selfless devotion, and the patient, persistent, careful work of the late Dr. T. S. P. Strangeways, who died two years ago. Neither academic distinctions nor scientific honours came his way, but no scientific man could wish for a finer reward than to have his name associated with an institution such as this laboratory.

Although radium is being used more and more extensively in the treatment of cancer, its use is still almost entirely empirical, for until recently little was known of its mode of action on either the normal or the malignant cell This was one of the problems which had engaged the attention of Dr. Strangeways during the last few years of his life, and by applying radium to cells cultivated *in vitro* and following the subsequent effects under the microscope in the living cell, he and his pupils have succeeded in obtaining information which has thrown a new light on this obscure problem, and has revealed the inadequacy of some of the *a priori* conceptions current among clinical radiologists

The beautiful kinematograph films of Dr. Canti, which many of our readers may have seen and admired, were made in collaboration with the Strangeways laboratory. This and other work is being continued, and it comes rather as a shock to find from the trustees' report that up to the present neither the director nor any research worker has received payment from the funds of the institution "This gift of service has in most cases been rendered possible only by the aid of fellowships or research grants from other sources. The tenure of benefactions of this kind is, however, limited to a few years, and if the excellent work which is being carried out at the Strangeways Research Laboratory is to continue and the foundation remain in its present form—a monument to the unselfish enthusiasm of its originator—its income must be increased sufficiently to enable it to provide salaries for a small permanent staff."

The staff consists of five research workers, with Miss Honor Fell as chief of the laboratory. This year a course of instruction in the technique of tissue culture will be given at the laboratory on July 9–Aug. 10. Since only a limited number of applicants can be received, notification from those wishing to take the course should be sent not later than June 30 to Dr. H. B Fell, Strangeways Research Laboratory, Cambridge.

Sugar Beet in England.

THE progress of the sugar beet industry in England has been followed with the closest attention since 1924, but the interest naturally increases with the approach of the end of the term of years during which the Government subsidy is in operation. The question which confronts the English farmer is not whether the crop can be grown in England, but whether it can be grown *profitably* when faced with the competition of the open market. Experiments of various kinds have been carried out in different parts of England to make a thorough investigation as to the best methods of cultivation, manuring, and harvesting, and at the same time the continental procedure has been closely studied in order to make the best possible use of their longer experience. It seems generally clear that profits can be made at the present time (about £5 per acre being quoted as an average from one area for last year), but the closest co-operation must be

built up between the growers and the factories, and costs still further decreased, before the industry can safely be regarded as self-supporting. Improvements made by the farmer will be of little avail if the crop is not marketed economically.

A comprehensive review of the situation is given in the "Report of the Second Sugar Beet Conference", held at Harper Adams College, and also in an article by E. C Pretyman in the *Journal of the Royal Agricultural Society*, vol. 89 It seems generally agreed that beet can be grown on a number of soils, but that the best crops are obtained on a deep soil there must be no deficiency of lime Seed should be sown plentifully on a carefully prepared seed bed in late April or early May, a dressing of dung if possible having been given to the preceding crop or in the previous autumn, though artificials can usually be applied with advantage instead Early singling is of the greatest importance, the distance between the plants not exceeding ten inches, the spacing between the rows should be the smallest possible to allow of thorough cleaning. Lifting should take place as soon as the crop is ripe, usually from mid-October to mid-November, in order to obtain the maximum sugar content. In this respect the continental farmer is at an advantage, in that his crop matures earlier than in England.

As regards harvesting implements, the ordinary lifting plough appears to be as suitable as any 'looseners' employed on the Continent, and the fundamental factor on which economic marketing depends seems to be efficient organisation of harvesting operations, rather than on the introduction of expensive machinery. Labour is the chief item in the grower's costs. Generally speaking, this is both more plentiful and cheaper in Germany and Belgium than in England, a large proportion of the work being done by well-organised gangs of labourers which travel round the country. If the beet is grown 'in shift', that is, in place of the ordinary root crop such as mangolds, the farmer in England has probably no need to obtain outside labourers, and in this way his costs are kept low On the other hand, his acreage and therefore his returns are also limited, and if at some distance from a factory transport introduces heavy charges. Co-operation alone provides a solution to these problems.

The question of improving the percentage sugar content in the beet is as yet imperfectly understood, but an increase in tonnage lies more in the farmers' hands and is certain to bring in a larger return. Returns can also be appreciably increased by an intelligent use of by-products; in fact, the financial success of the beet crop may depend on it. The tops, as well as the wet or dry pulp available at a low price from the factory, are valuable as cattle food, and the continental farmers invariably make full use of them for this purpose. Reduction in factory costs is all-important for the success of the industry. Heavy expense is incurred owing to the factories lying idle except during a few months in the autumn and winter, and if the extraction process could be continued throughout the year, an appreciable reduction in costs could be made A new system is now on trial at the Eynsham factory with the view of achieving this by means of subjecting the beet to a drying process. It is claimed that the dried slices or 'cossettes' can be stored without undergoing deterioration or loss in sugar content, but the method has still to be proved before any far-reaching claims can be made for it.

The future of the industry in England cannot yet be predicted, but there seems no reason why it should not prove successful if every effort is made to reduce costs to a minimum, and to secure the closest co-operation between the grower and the factory.

Jubilee of the Hellenic Society.

ON June 24 the Society for the Promotion of Hellenic Studies will celebrate the fiftieth anniversary of its foundation On the afternoon of that day a commemorative meeting will be held in the Stationers Hall, Ave Maria Lane, at 3 P.M The chair will be taken by Mr Arthur Hamilton Smith, president of the Society, who will deliver his presidential address. Prof. Gilbert Murray has promised to speak, and addresses and greetings from friendly and allied bodies will be presented. In the evening of the same day a festival dinner will take place at the Criterion Restaurant, at which Mr. A. Hamilton Smith will preside The guest of the evening will be Lord D'Abernon, who will propose "The Prosperity of the Society", a toast in which he will be supported by Sir James Frazer. The reply has appropriately been entrusted to Mr. George Macmillan, honorary secretary of the Society from 1879 to 1919, and now honorary treasurer, to whom the Society has been deeply indebted throughout its history for his unceasing activity on its behalf

When the Hellenic Society, as it is familiarly, if incorrectly, called, was founded in 1879, the extent and character of the influence it was to exert in humanistic studies could scarcely have been foreseen. Not only was the trend of the political situation at that time obscure; it was also necessary that those who controlled the Society should be at some pains to define its activities in order to remove an impression from the mind of the public to whom it hoped to appeal, that its aims were not exclusively literary. Accession to its numbers was rapid and influential. At the second annual meeting the council was able to announce a membership of nearly four hundred, while the first page of the original candidates' book reads like a scholars' roll call with such names as Canon Seddon, Dr Donaldson, J. R Green, J. E C Welldon, Rev. J. A. Magrath, and Robinson Ellis, to name a few only. In regard to the scope of its activities, there is no side of the life and art of ancient Greece on which it has not touched, but above all it has earned the undying gratitude of the scholar and historian by the way in which, both as a body and through its individual members, it has fostered research in the prehistory of the Eastern Mediterranean.

Within the years of the life of the Society, Sir Arthur Evans, always one of its most prominent members, has revealed an entire civilisation second to none in importance in the history of human culture. More directly, perhaps, is gratitude due for the active interest taken by the Society in the foundation of the British School of Archæology in Athens, the practice ground of a distinguished line of British archæologists and scholars. The foundation of such a school was the subject of discussion in the council from the early days of the Society This bore fruit in the opening of the School in 1886. Fittingly enough one of the two memorial volumes to be issued in connexion with the anniversary deals with the excavation of the sanctuary of Artemis Orthia at Sparta carried out by the School, and is edited by Prof R M. Dawkins, a former director The second volume, by Mr. George Macmillan, is a history of the Society

University and Educational Intelligence.

CAMBRIDGE.—The Ministry of Agriculture and Fisheries has informed the secretary of the School of Agriculture that a grant not exceeding £3000 has been sanctioned by the Empire Marketing Board for the provision of buildings to investigate the use of B C G. vaccine in the protection of calves against tuberculosis.

Dr. Marshall has been reappointed reader in agricultural physiology.

Mr. F. P. Ramsey, King's College, has been reappointed University lecturer in mathematics.

The electors to the Isaac Newton Studentships give notice that an election to a studentship will be held early in the Michaelmas Term, 1929. These studentships are for the furtherance of advanced study and research in astronomy

EDINBURGH.—Sir Alfred Ewing, who is retiring from the principalship of the University, and Lady Ewing have received warm testimony of the esteem in which they are held in Edinburgh. On June 11 a portrait of Sir Alfred was presented to the University and a replica to Lady Ewing at a large gathering of subscribers in the Upper Library Hall. The presentations were made by the Lord Provost, and Sir John Gilmour, Lord Rector of the University, accepted one of the portraits on behalf of the University The portraits, by Mr. Henry Lintott, R S A , represent Sir Alfred in his robes as Vice-Chancellor. On June 14, at a great gathering in the M'Ewan Hall, gifts from the students were presented to Sir Alfred and Lady Ewing, who, on leaving the hall, were accorded a great demonstration and were drawn in a decorated carriage by way of Princes Street to their house in Moray Place. On June 18 the members of Senatus entertained Sir Alfred at dinner in the Senate Hall Lady Ewing has also received a gift from the wives of the members of the staff of the University

The resignations are announced of Dr. R. Stewart MacDougall, reader in agricultural zoology, who has been responsible for the teaching in agricultural and forest entomology since 1906, and of Dr. John Stephenson, lecturer in zoology (invertebrates) since 1920 and formerly professor of zoology and principal of Government College, Lahore

MANCHESTER —The Council has accepted a gift of £1500 from Messrs Benger's Food, Ltd. This amount, together with a previous gift of £500 from the same source, is to be devoted to the furnishing and equipment of the new laboratories for pharmacological and pharmaceutical chemistry, which will bear the name of the " Benger Laboratories "

The Grisedale scholarships for biological research, previously of £100 each, will in future be combined in one annual scholarship of £200. In the present year two scholarships of £200 will be offered, and application must be made to the Registrar not later than June 22.

DR. LEWIS F. RICHARDSON, who is in charge of the Physics Department, Westminster Training College, London, has been appointed Principal of Paisley Technical College.

THE Royal Commission for the Exhibition of 1851 has made the following appointments to the five Senior Studentships offered for award in 1929 .—On the recommendation of the University of Cambridge Mr. F. P. Bowden (Tasmania), for research in physical chemistry; Mr. C. S. Hanes (Toronto), for research in plant physiology; Mr. M. L. E. Oliphant (Adelaide), for research in experimental physics, Mr. B. Woolf (Cambridge), for research in biochemistry, all at the University of Cambridge. On the recommendation of the Imperial College of Science and Technology: Dr W. F. Whittard (London and Cambridge), for research in geology and zoology at the Imperial College of Science and Technology.

THE National Congress of Parents and Teachers in the United States, which had in 1928 a membership of 1,279,000, is engaged in a strenuous campaign for promoting child welfare through the stimulation of parental interest and sense of responsibility. In the December issue of *School Life* an account is given of one of its activities known as ' the summer round-up of the children ', the essential features of which are · (1) A physical examination on or before May 1 of all children who will be due to enter school for the first time in the following autumn ; (2) the application during the summer of appropriate treatment for remediable defects, and (3) a second inspection in the autumn to ascertain the extent to which the defects have been corrected The aim, of course, is to ensure for as many children as possible a fair start on their school career Begun in 1925, this enterprise has been successful, whilst maintaining the closest relation and most helpful co-operation with the regular health agencies, in securing the personal activity of the parents. Clearly the parents thus early aroused to the need of preventive and corrective measures are likely to continue to take an intelligent interest in such matters—and this view has been abundantly confirmed An investigation made after the first of these ' round-ups ' indicated that less than 3 per cent of the children examined were not in need of remedial treatment The campaign has the support and co-operation of the United States Bureau of Education, the American Medical Association, and other important bodies, and numerous doctors, dentists, and nurses give their services freely in the examinations.

THE Report on the work of the Department of Petroleum Technology of the Sir John Cass Technical Institute for the session 1928–29 has just been issued While differing but little from that of the previous session, in so far as the schedule of work and organisation is concerned, it is clear that steady progress is being maintained, and that the particular body of men for whom the courses are specially designed, namely, those engaged in clerical and administrative branches of the industry, is deriving a considerable benefit therefrom The necessity for co-operation between industry and educational authorities has been sufficiently voiced ever since the War, in a recently published Board of Trade report, this policy is re-emphasised, and each great industry is enjoined to " make its own educational needs the subject of thorough and systematic examination " While the oil industry as a whole can certainly be acquitted of any charge of neglect on this score, the Sir John Cass Institute has gone more than half-way in giving practical expression of the desire of the academic world to do its share There can be no possible excuse for any non-technically trained man in the industry who desires to widen his knowledge and thus to better himself, if he does not take full advantage of such instruction as is here provided. The chief subjects covered during the session were general technology of petroleum, chemical and physical properties, methods of examination of oils, and the applications of engineering. It is satisfactory to note that two most important subjects were included in the work of this session: " Developments in Lubrication " and " Geophysical Methods as applied to Oil-finding " This in itself is sufficient testimony to the thoroughly modern character of the curriculum and, incidentally, significant of the value attaching to the policy adopted by the Governors for the past eight years, that of keeping in close touch with prominent men in the industry in its several specialised branches.

Calendar of Patent Records.

June 23, 1789 —General Henry Seymour Conway, nephew of Sir Robert Walpole, and Secretary of State from 1765 until 1768, was granted a patent on June 23, 1789, for utilising the waste heat from coke-ovens and conveying it through pipes "for the working of steam engines, the baking of bread, meat, or other food, the calcining and fusing of ores and metals, the making of brass and steel, as also for the purpose of warming rooms, staircases, large buildings, and for heating water"

June 24, 1738 —The patent granted to Lewis Paul on June 24, 1738, includes the earliest example of cotton-spinning by roller-drawing, the specification describing a process in which the prepared sliver having been passed through one set of rollers, "a succession of other rowlers, cillinders, or cones, moving proportionately faster than the first, draw the sliver into any degree of fineness which may be required" There is, however, very little evidence to show that this part of the invention was ever put into practical operation, and the main credit for the introduction of roller spinning must be given to Sir Richard Arkwright.

June 24, 1856 —The system of interlocking railway points and signals was the invention of John Saxby, of the L B. & S C. R, and was patented by him on June 24, 1856. The advantages of the new system were at once recognised and it was generally adopted Works were started by Saxby first at Haywards Heath and then in London, and branch factories were opened in Brussels and Paris.

June 25, 1761 —An early attempt at the manufacture of the parts of watches by machinery was made by George Sanderson, watchmaker, of Exeter, who was granted a patent for his invention on June 25, 1761. On the same date, June 25, a year later, a second patent was sealed to Sanderson for a "lunar and calendar watch-key", in which a calendar mechanism in the key was caused to advance one day by the act of winding the watch. According to Britten, keys on this plan were made by Etienne Tavernier of Paris at the end of the eighteenth century.

June 26, 1799.—The first self-acting carding-machine for making wire cards for preparing wool and cotton was patented by Amos Whittmore and Clement Sharp of London on June 26, 1799. The machine bent and cut the wires, pricked holes in the leather, and inserted the teeth into the holes by one operation, but the cards produced by it were too coarse to supersede the hand-made cards in Great Britain, where the art had been brought to great perfection. The inventors therefore took their machine to America, where it proved very successful owing to the lack there of efficient card-makers. Afterwards, the patent was acquired by the American, J. C. Dyer, who so greatly improved the machine that he was able to reintroduce it into Great Britain and to establish a considerable trade His improved machine was patented in 1811.

June 27, 1838.—The successful production of seamless brass and copper tubing is due to Charles Green, of Birmingham, whose patent for the process was granted on June 27, 1838. The invention, similar to John Wilkinson's earlier process for making lead tubes, consisted in drawing a thick tubular ingot, the internal diameter of which was approximately the same as that required for the finished tube, until it had been reduced to the requisite thickness The inventor proposed to use on his drawbench four rollers arranged at right angles, the periphery of each being hollowed out so that when brought together a complete circle was formed.

Societies and Academies.

EDINBURGH

Royal Society, June 3.—**W. C. M'Intosh** On abnormal teeth in some mammals, especially in the rabbit In the Primates the chief irregularities are the development of extra molars, the narrowing of the tip of the lower jaw so that the incisors and canines are crushed from their normal positions, asymmetry of the muzzle, gaps between the teeth, and bulging of the rows of grinders internally or externally In the Carnivora, gaps between the incisors in the maxilla and mandible, displacement and duplication of canines and duplication of incisors are found. In forms suffering from peridentitis salivary calculi occasionally occur. Displacement of a canine may be accompanied by an aperture in the hard palate into which the tooth fits. About twenty Rodents other than rabbits have been found with abnormal teeth, amongst which striking cases exist in the beaver, hare, and the brown rat, the right mandibular incisor in the former making more than a circle and penetrating the soft parts In the teeth of the sperm whale the dentine and cement may be diseased and abraded. The folding of the root of the small tusk of the female dugong is noteworthy. In the Ungulates and marsupials numerous abnormalities present themselves Special attention was devoted to the rabbit, abnormal teeth in which were described in about 100 cases and grouped temporarily into (1) those with the upper incisors more or less symmetrically curved outward; (2) upper incisors deflected to one side, (3) upper incisors curved into the mouth. The old view of such dental abnormalities being due to external injury must be abandoned, since in every group congenital causes or diseases were usually at the root of the abnormalities.—**Ian Sandeman**: Bands in hydrogen related to the Fulcher system. The $3^3S \rightarrow 2^3S$ system of Richardson and Das is extended, the band previously given as the null band (0, 0) now being taken as (2, 0), while two additional vibrational levels are added on the infra-red side.—**J. A. V. Butler** and **W. O. Kermack**: The action of salts of polynuclear bases on colloidal suspensions and on the electro-capillary curve In small concentrations, salts of 5 . 6-benz-4-carboline and its derivatives effect precipitation of colloidal gum benzoin and other negatively charged lyophobic colloids, but when higher concentrations are used no precipitation occurs and the colloidal particles acquire a positive charge. Experiments on the precipitation of colloidal gum benzoin by mixtures of benz-carboline and gelatin indicate that the presence of the gelatin tends to decrease the adsorption of the benz-carboline. Benz-carboline sols, present in low concentration (M/20,000), exercise a marked effect on the electro-capillary curve of mercury, the depression being maximum on the positive side of the maximum of the primary, that is when the mercury is positively charged relative to the solution The results indicate that benz-carboline ions undergo marked adsorption even on a positively charged surface —**Sir Thomas Muir**. The theory of skew determinants and pfaffians from 1891 to 1919

DUBLIN.

Royal Irish Academy, June 10.—**R Lloyd Praeger**: Report from the Fauna and Flora Committee on recent additions to the knowledge of the fauna and flora of Ireland. The report deals with recent progress in our knowledge of a large number of Irish animal and plant groups, and where a previous comprehensive report has been published, it gives a detailed account of all additions —**R. Lloyd Praeger**:

Sempervivа of the Canary Islands area, with special reference to hybrids The paper was mainly the results of four months' work in the Canary Islands in 1927, and dealt especially with the occurrence of numerous hybrids among the species of *Sempervivum* which form so marked a feature of the vegetation of that region —**J Kaye Charlesworth** The glacial retreat in Iar Connaught The glaciers of the ice-centre of Iar Connaught overrode the western part of the Central Plain of Ireland, and on their retreat deposited the marginal accumulations about Lough Corrib and Lough Mask On the inner side of these moraines there lies a wide zone devoid of moraines This zone is followed by the central area of the submontane and cirque moraines of the local glaciation of Iar Connaught They probably denote a new advance of the ice —**J J Drumm, R J P Carolan, and Hugh Ryan** The constitution of iso-catechin tetramethyl ether Iso-catechin tetramethyl ether was prepared from chloro-catechin tetramethyl ether by indirect hydrolysis It consisted of colourless crystals melting at 121°-122° C, whereas catechin tetramethyl ether melts at 146°-147° C The preparation of iso-catechin tetramethyl ethyl ether and of iso-catechin tetramethyl methyl ether are also described Both of these are optically active but differ markedly from catechin tetramethyl ethyl ether and catechin tetramethyl methyl ether respectively in optical activity and melting point The racemic form of iso-catechin tetramethyl ether and of iso-catechin tetramethyl methyl ether could not be obtained by the reduction of the respective ethoxy- and methoxy-pyrylium colour bases, which latter, together with chloro-catechin tetramethyl ether were first produced by Drumm (*Proc. R. I Acad*, **36**, B 5 (1923), p 46) The work is in agreement with that of Freudenberg (*Annalen d. Chemie*, 1925, 446, 87) who has shown that in the preparation of the chloro-catechin tetramethyl ether of Drumm (loc cit) a pinacoline transformation takes place involving a wandering of the veratryl group with consequent formation of an $\alpha\beta$-diphenyl propane derivative, catechin itself being an $\alpha\gamma$-diphenyl propane derivative —**J. J Drumm, Sheila M Maguire, and Hugh Ryan**: -3 4 -Dimethoxybenzyl-3 5-dimethoxycoumaranone The previous work of Drumm, MacMahon, and Ryan (*Proc R I Acad.*, **36** B (1924), p 154) had shown that the reduction of veratrylidene -3 5-dimethyoxycoumaranone by means of hydrogen in presence of platinum black gave rise to a dihydro compound, in the formation of which latter compound it was assumed the veratrylidene double bond was reduced, leaving the carbonyl group untouched It is now shown that in the above reduction the carbonyl group is unaffected, for on treatment with phenyl magnesium bromide, a colourless crystalline carbinol is obtained, melting at 82°-83° C. This carbinol on bromination in the ordinary way yields a monobromo derivative melting at 115° C

PARIS.

Academy of Sciences, May 13.—**Guido Ascoli** The approximate representation of functions —**J Delsarte** The Fredholm transformations rendering invariant a quadratic functional —**Coulomb** A formula of quantic algebra —**Fahir Emir** A new determination of the thickness of a film of oleic acid in the state of saturation on water and of the saturation pressure of this film The experimental results given agree well with those of Marcelin as regards the thickness of the saturated film, but the figures for the saturation pressure are definitely lower The causes of the difference are discussed. The film has the same thickness on distilled water and on weak ($N/20$) hydrochloric acid —**Pierre Auger** The theory of the photo-electric effect The formula recently deduced by A Sommerfeld gives a distribution formula in good agreement with experiment —**Mme and M. Lemarchands** The constant of equilibrium in double decompositions in aqueous solution A study of the reversible reaction $BaSO_4 + 2HCl = H_2SO_4 + BaCl_2$. From the equilibrium constants at 18° C and 100° C. and the application of the van 't Hoff equation, a figure for the heat of reaction is found which agrees within the limits of experimental error with the direct thermochemical determination —**H Colin and A. Chaudun** The concentration of the sugar and velocity of hydrolysis in acid solution —**Mlle Suzanne Veil** The ferromagnetic properties of the ferrites —**Ch. Bedel** Some conditions of solubility of silicon in hydrofluoric acid Hydrofluoric acid in the presence of oxidising agents (potassium permanganate, chromic acid, ferric chloride, hydrogen peroxide) dissolves silicon readily The nature of the metal forming the containing vessel also exerts an influence on the rate of solubility —**Swigel Posternak and Théodore Posternak** The configuration of inactive inosite —**Georges Mignonac and Odd W. Rambeck** The action of cyanogen chloride, bromide, and iodide on the sodium compound of ethyl malonate The syntheses of ethane tetracarboxylic acid and ethylene tetracarboxylic acid The cyanogen halides do not react similarly. Sodium ethyl malonate, in ether solution, gives mainly ethylmalonic ether with cyanogen chloride replacement of the latter by cyanogen bromide gives a mixture of the ethyl ethers of ethylene tetracarboxylic acid and ethane tetracarboxylic acid The latter substance is the sole product when cyanogen iodide is used —**Mme Ramart-Lucas and F Salmon-Legagneur** The comparative stability of isomers from their absorption spectra (Dehydration of glycols, isomerisation of ethylene oxides)—**L Royer** The corrosion of a crystal of dolomite by an active isotropic liquid A comparison of the corrosion figures of dolomite produced by active and by inactive organic acids shows that the result is affected by both the optical symmetry of the crystal and by that of the acid —**Jean Chevrier** The daily variation of the electrical potential of the air and of electrical loss during the month of September 1928 at the Observatory of Ksara (Liban) —**Paul Becquerel** The latent life of pollen grains in a vacuum at −271° C. Pollen grains (*Antirrhinum, Nicotiana*) after drying over caustic baryta, were placed in a tube from which the air was removed as completely as possible with a Langmuir condensation pump and then sealed up. The tubes were placed in liquid helium (temperature −269° to −271° 7 C.) for seven hours and kept for five months. The germinating power remained unaltered by this treatment, although similar grains preserved in dry air for seven months lost their germinating power.—**Raymond-Hamet** Pharmacological applications of the technique of the kidney transported to the neck —**René Fabre and Henri Simonnet** The physical and biological study of the dextrorotatory sterol isolated from beer yeast. The slight curative effect (antirachitic) observed with irradiated zymosterol is regarded as probably due to traces of ergosterol left in the product in spite of careful purification.—**Edouard Chatton and Mme M Chatton** The conditions of conjugation of *Glaucoma scintillans* in lethobacterial cultures. The direct and specific action of certain zygogen agents —**H. Pénau and G. Tanret**. A dextrorotatory sterol of yeast, zymosterol Details of the method of preparation from yeast, purification, analysis, physical and chemical properties The alcohol is not simply isomeric with ergosterol as it contains two hydroxyl groups and has the formula $C_{27}H_{40}(OH)_2$ —**H Jacotot**. The preparation of a

hyperactive serum against cattle pest.—**V. Zernoff**. An attempt at serotherapy in *Galleria melonella*. The injection of the blood of vaccinated larvæ produces a curative effect, and this curative property of the blood of vaccinated larvæ may be preserved for several days *in vitro*.

ROME.

Royal National Academy of the Lincei, Mar 3 — **G. Fubini** The canonical pencil —**G Armellini** The horizontal diameter of the sun in 1927 and 1928. Measurements of the horizontal diameter of the sun during its passage of the meridian, made at the Campidoglio Observatory by various observers, give the following mean values for the past few years 1924, 16′ 1 03″; 1925, 16′ 0 63″; 1926, 16′ 1·02″, 1927, 16′ 1·54″, 1928, 16′ 1 58″—**A Comessatti** Galois' curves (2) —**G. Scorza-Dragoni**. Integrals of the equation, $y' = f(x, y)$ —**G Krall** Local limitations of dynamic effort —**A Wundheiler** A generalised displacement in Riemannian spaces. In a paper published last year, Gerhard Thomsen described applications of a new notion of parallelism in Riemannian spaces, termed the Fermi parallelism The latter is defined by certain properties, which lead to a formula worked out by Thomsen in the particular case when the displaced vector is orthogonal to the curve of transport. In the present paper the general formula for this displacement is derived.—**G. Vitali**. The centres of curvature of the geodetics of a variety It is shown that, if P is a point of a variety V_n of n dimensions, in which the σ_2 of V_n has $n+\nu$, $\nu = (n+1)/2$ dimensions, the centres of curvature in P of the ∞^{n-1} geodetics of V_n issuing from P are situate on a hyper-sphere K passing through P of the linear space S_ν of ν dimensions lying in σ_2 and perpendicular to Vn —**F. Lamberti** Two particular dynamic equations of a linked material system —**Gabriella Armellini Conti** Colorimetric observations made during the total eclipse of the sun on June 29, 1927. A series of photographs, taken at Ringebu (Norway), of a polychrome screen exposed to the sun's light confirm the red coloration of the light apparent during the eclipse —**L. Martinozzi** The electrical characteristics of meteorites (the hypothesis of an electrical origin of their luminosity) and a limiting value for the density of the ions in the upper atmosphere Burgatti (1927) has advanced the view that the luminosity of meteorites may be of electrical origin. A simple calculation, made on the basis of certain assumptions, of the electrical charge necessary to a meteorite in order that bombardment of the ions present in the zones traversed may render it luminous, leads to somewhat high values for this charge and hence for the corresponding potential. Taking into account the fact that the charge should be negative, the values found are not easily explained, since, as Burgatti pointed out, it would be more reasonable to expect that meteorites would become positively charged by photoelectric action; nothing is, however, known concerning the distribution of potential in the universe The necessary value calculated for the number of ions per c.c agrees well with the number required for Heaviside's reflecting layer — **E. Amaldi and E Segrè** The theory of the Raman effect The mechanism of the Raman effect proposed by Smekal and generally accepted would indicate that Raman lines corresponding with very intense infra-red bands should be also very intense Observations have failed to confirm the existence of any such relationship, and it is now shown that the experimental results are in complete accord with the theories of Schrodinger and Dirac, and that with any Raman line there corresponds, not necessarily an infra-red absorption band, but simply the difference between two terms; only when, by chance, such two terms combine directly will an infra-red line exist —**L. Fernandes**. Investigations on sulpho-salts (8) Persulpho-salts.—**G. Malquori**· The system $Fe(NO_3)_3 - KNO_3 - HNO_3 - H_2O$ at 25°.—**F de Carli**. The double carbonate of cobalt and potassium. The double salt, $CoCO_3$, K_2CO_3, $4H_2O$, may be completely dehydrated by heating it at 120° in a current of carbon dioxide Measurement of the dissociation tension at various temperatures, and application of Nernst's approximate formula, give for the heat evolution corresponding with the equation, $Co + 1\frac{1}{2}O_2 + C = CoCO_3$, the value 169 43 or 163·13 Cal, according as the heat of formation of CoO is taken as 63·80 or 57·59 Cal. Calorimetric determination gives the value 173·31 Cal —**A Pieroni**. Naphthophenoxanthones $\alpha\beta$-Naphthophenoxanthone cannot be obtained by the general reactions serving for the preparation of the $\beta\beta$- and $\beta\alpha$-isomerides, possibly owing to the ready elimination of the carboxyl in the α-position of the naphthalene nucleus, but is formed when α-benzoyl-β-naphthol is heated with aluminium chloride for 2 hours at 150°, it crystallises in golden-yellow needles melting at 173°, and its solution in sulphuric acid is yellow and shows an intense green fluorescence.—**T. G. Levi**. 1 3 : 5-Dithioazine (formothialdine). This, the first member of the thialdine series, has not previously been described It may be obtained, together with trithioformaldehyde, by treating aqueous formaldehyde solution with sulphur or, better, ammonium hydrogen sulphide —**Giulia Martinez** Heulandite from Monastir.—**R. Grandori**· Symbiotic micro-organisms in the egg of *Pieris brassicæ L*

VIENNA.

Academy of Sciences, Feb 28.—**A. Haas**. Stefan's law and the theory of light quanta The number of light quanta emitted is proportional to the third power of the temperature, whilst the average energy of the single light quantum is proportional to the temperature itself —**R Bortsch** The determination of stresses in discs with arbitrary boundaries.—**A Dadieu and K. W. F Kohlrausch** Studies on the Raman effect (1) The Raman spectrum of organic substances (fatty acids and their esters).—**R. Weiss and A Kratz** A new synthesis of cumarine derivatives (2)

Mar 7 —**A Kailan and A Schachner** The velocity of esterification of fatty acids with ethylene-glycolic hydrochloric acid —**W. J. Muller**. The theory of passivity phenomena (5) The influence of covering films on the potential of a metal —**G Koller, H Ruppersberg, and E. Strang**. The condensation of o-amino-benzaldehyde with keto-dicarbonic-acid esters and di-keto-carbonic-acid esters —**R Dworzak and K. Hermann**. Cyclic acetals (2).—**W Schmidt** The structure of the wind To obtain the simultaneous wind velocities at a series of adjacent points a new method of observation was worked out. Light pressure plates in great numbers were brought together and photographed kinematographically The experiment was made on an area of 10 × 10 metres —**F Holzl** The alkylisation of tri- and tetra-cyano-cadmic acids — **K. Funke and H. Wolf** Researches on perylene and its derivatives (23rd communication) —**A Pongratz**· 24th communication.—**A Zinke and W. Hirsch**. 25th communication

Mar. 14 —**W. J Muller and K. Konopicky** The anodic behaviour of aluminium. An inquiry arising out of the surface passivity of aluminium.—**R. Wegscheider** The photochemical transformation of o-nitro-benzaldehyde —**E Spath and N Polgar**. The

quaternary bases in *Berberis vulgaris*. Besides berberin there is also palmatin, iatrorrhizin, columbamin, and berberrubin —E Spath and G. Papaionou · Phenol bases in the bark of Angostura; synthesis of galipolin.—R. Dworzak and J. Pierri Studies on α-bromo- and oxy-aldehyde —C. Doelter Blue rock salt —F. Hochstetter Contributions to the developmental history of the human brain —K Fritsch Observations on flower-visiting insects in Styria, 1909 *Helleborus niger* had many visitants on sunny days in its natural localities, *Prunus avium* was visited by *Macroglossa fuciformis* Other observations supplementary to Knuth's work —G Ortner Measurement of strong polonium preparations by means of the charge transported by the emitted α-particles —F Holzl, Th. Meier-Mohar, and F. Viditz Alk-oxonium-hexa-cyano-cobaltates —K Menger (1) A partition theorem for rational and irrational dimensional assemblages (2) The nowhere dense partial assemblages of *Rn* (3) Deducing the concept of dimension from postulates —E Deussen The composition of iron fluoride

Official Publications Received.

BRITISH

Malayan Forest Records, No 6 Mangrove Forests of the Malay Peninsula By J G Watson Pp viii+275 (Kuala Lumpur, F M S Conservator of Forests) 3 dollars , 7s

Commonwealth of Australia Second Annual Report of the Council for Scientific and Industrial Research for the Year ended 30th June 1928 Pp 38 (Canberra, F C T H J Green) 1s 8d

Memoirs of the Punjab Irrigation Research Laboratory Vol 1, No 2 A Statistical Examination of the Sensitivity of a Water Table to Rainfall and Irrigation By Bernard Howell Wilsdon, with R Partha Sarathy Pp 24 (Lahore Government Printing Office) 1 rupee , 1s 6d

Report of the Botanical Survey of India for 1927–28 Pp 8 (Calcutta)

Tanganyika Territory Report of the Department of Agriculture for the Year ending 31st March 1928 Pp 57 (Dar es Salaam) 2s 6d

Miscellaneous Publications of the Royal Alfred Observatory No 7 The Cyclone Season 1927–1928 at Mauritius By R A Watson Pp 4+47 charts (Mauritius)

The Research Association of British Paint, Colour and Varnish Manufacturers Technical Paper No 1 Tung Oil, a Review of the Possibilities of Production within the British Empire, with a Complete Bibliography of the Literature relating to Tung Oil from 1917-1927 excluding Patents By Dr L A Jordan Pp 40 (Teddington)

Journal of the Marine Biological Association of the United Kingdom New Series, Vol 16, No 1, May Pp 363 (Plymouth) 12s 6d net

Journal of the Royal Statistical Society New Series, Vol 92, Part 2 Pp 163-321+xii (London) 7s 6d

Transactions of the Optical Society Vol 30, No 3, 1928–29 Pp iv+101-140 (London) 10s

Seale-Hayne Agricultural College, Newton Abbot, Devon Department of Plant Pathology Fifth Annual Report for the Year ending September 30th, 1928 (Pamphlet No 30) Pp 40 (Newton Abbot)

Annals of the Natal Museum Edited by Dr Ernest Warren Vol 6, Part 2, May Pp 171-336+plates 12-22 19s net Vol 5, Index Pp v+449-458 (London Adlard and Son, Ltd)

Falmouth Observatory Report of the Joint Observatory Committee to the Royal Cornwall Polytechnic Society and the Falmouth Town Council for the Year 1928 Pp 5 Meteorological Notes and Tables for the Year 1928, also Table of the Mean Magnetic Declination at Falmouth, from 1888 to 1928 By W Tregoning Hooper Pp 7 (Falmouth)

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1208 (Ae 369) A Dash-Pot for use in Spinning Experiments on a Model Aerofoil By T H Fewster (T 2691) Pp 2+1 plate 4d net No 1209 (Ae 362) Wool-Tufts , a Direct Method of discriminating between Steady and Turbulent Airflow over the Wing Surfaces of Aircraft in Flight, applied to explore the Region of Effect of the Slot on a Bristol Fighter Wing By Flight-Lieut J A G Haslam

net No 1212 (Ae 371) Preliminary Tests on the Effect on the Lift of a Wing of the Position of the Airscrews relative to It By F B Bradfield (T 2716) Pp 10+4 plates 9d net (London H M Stationery Office)

Harper Adams Agricultural College, Newport, Salop Some Cattle Diseases—Contagious Abortion, Tuberculosis, Mastitis (Garget) Report of Conference held at the College on Tuesday, April 9th Pp 24 (Newport, Salop)

Gold Coast Survey Tables for use in the Department Pp 46+2 plates (Accra)

Journal of the Chemical Society containing Papers communicated to the Society May Pp iv+853-1111+x (London)

Proceedings of the National Laboratory of Psychical Research Vol 1, Part 2 Short-Title Catalogue of Works on Psychical Research, Spiritualism, Magic, Psychology, Legerdemain and other Methods of Deception, Charlatanism, Witchcraft and Technical Works for the Scientific Investigation of alleged Abnormal Phenomena from Circa 1450 A D to 1929 A D Compiled by Harry Price Pp 65-422+32 plates (London) 15s net

The National Benzole Association Sixth Report of the Joint Benzole Research Committee of the National Benzole Association and the University of Leeds Pp ii+212 (London)

Proceedings of the Geologists Association Edited by A K Wells Vol 40, Part 1, May 22 Pp 104 (London Edward Stanford, Ltd) 5s

The Royal Society for the Protection of Birds Thirty eighth Annual Report, January 1st to December 31st, 1928 , with Proceedings of Annual Meeting, 1929 Pp 108 (London) 1s

The National Physical Laboratory Inspection by the General Board, June 18th, 1929 Pp 15 (Teddington)

Rothamsted Experimental Station, Harpenden Investigations in Progress in the Laboratories and Experimental Fields, 1929–30 Pp 12 (Harpenden)

Empire Cotton Growing Corporation Report of the Administrative Council of the Corporation to be submitted at the Eighth Annual General Meeting on June 3rd, 1929 Pp 55 (London)

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich , read at the Annual Visitation of the Royal Observatory, 1929 June 1 Pp 17 (Greenwich)

South Australia Empire Forestry Conference, 1928 Forestry Handbook Prepared by E Julius and A L Pinches Pp 146 (Adelaide Harrison Weir)

The Indian Forest Records Silviculture Series, Vol 13, Part 8 Volume and Outturn Tables for Blue Pine (*Pinus excelsa*, Wall) By H G Champion, Ishwar Das Mahendru and Parma Nand Suri Pp iv+46 (Calcutta Government of India Central Publication Branch) 1 2 rupees , 2s

Department of Education National Library of Ireland List of Scientific and Technical Periodicals in Dublin Libraries Pp vi+147 (Dublin Stationery Office) 5s net

Proceedings of the Royal Society Series A, Vol 124, No A794, June 4 Pp 243-477 (London Harrison and Sons, Ltd) 8s

Philosophical Transactions of the Royal Society of London Series A, Vol 228, A 663 A Photographic Investigation of Flame Movements in Carbonic Oxide-Oxygen Explosions By Prof William A Bone and Reginald P Fraser Pp 197-234+11 plates (London Harrison and Sons, Ltd)

The Strangeways Research Laboratory, formerly the Cambridge Research Hospital Pp 16 (Cambridge)

Transactions and Proceedings of the New Zealand Institute Vol 59, Part 4, December 1928 Pp ix+663 1024+xii (Wellington, N Z)

The Indian Forest Records Silviculture Series, Vol 14, Part 2 Denudation of the Punjab Hills By B O Coventry Pp v+30+7 plates (Calcutta Government of India Central Publication Branch) 1 4 rupees , 2s 3d

Journal of the Indian Institute of Science Vol 12A, Part 5 Studies on Soil Actinomyces i Introduction, by V Subrahmanyan and Roland V Norris , ii Their Mode of Occurrence in the Soil, by V Subrahmanyan Pp 53-68 (Bangalore) 1 rupee

Commonwealth of Australia Council for Scientific and Industrial Research Pamphlet No 11 The Tasmanian Grass Grub (*Oncopera intricata*, Walker) , a Preliminary Report on its Life History and Methods of Control By Gerald F Hill Pp 43 (6 plates) (Melbourne H J Green)

South Australia Department of Mines Mining Review for the Half-Year ended December 31st, 1928 (No 49) Pp 93+8 plates (Adelaide Harrison Weir)

FOREIGN

Reprint and Circular Series of the National Research Council No 87 Final Report of the Committee on Scientific Problems of Human Migration Pp 21 (Washington, D C National Academy of Sciences) 30 cents

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Sudan Government Wellcome Tropical Research Laboratories, Khartoum Report of the Government Chemist for the Year 1928 (Chemical Section, Publication No 59) Pp iv+39 (Khartoum)

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Classified List of Publications of the Carnegie Institution of Washington Pp 202 (Washington, D C Carnegie Institution)

Carnegie Institution of Washington Fourteenth Issue Pp 63 (Washington, D C Carnegie Institution)

Proceedings of the United States National Museum Vol 74, Art 6 Notes on some Oriental Sapromyzid Flies (Diptera), with particular reference to the Philippine Species By J R Malloch (No 2751) Pp 97+6 plates Vol 74, Art 7 A Revision of the Wood-Warbler Genus Basileuterus and its Allies By W E Clyde Todd (No 2752) Pp 95 Vol 75, Art 11 A Contribution to our Knowledge of the Anatomy of the Fresh-water Mussels of the District of Columbia By Lucy Reardon (No 2782) Pp 12+5 plates (Washington, D C Government Printing Office)

Annuaire de l'Academie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, 1929 95e annee Pp 155+4 planches (Bruxelles Maurice Lamertin)

Annuaire de l'Observatoire Royal de Belgique 97e annee, 1930 Pp 100 (Uccle)

Annales de l'Observatoire Royale de Belgique Troisieme série, Tome 2, Fascicule 2 Catalogue de 419 etoiles de comparaison pour la planete Eros à son opposition de 1930-1931 Par F Moreau, G Becq, L de Clerck et J Verbaandert Pp 77-102 (Uccle)

Journal de la Societe des Americanistes de Paris Nouvelle serie, Tome 20 Pp xxxii+589 (Paris)

Ministere de l'Instruction publique et des Beaux-arts Enquêtes et documents relatifs a l'enseignement superieur 123 Rapports sur les Observatoires astronomiques de Province et les Observatoires et Instituts de Physique du Globe Annee 1927 Pp 108 (Paris)

Publications of the Far Eastern State University Serie 7, No 12 Adsorption as a general Characteristic of Coal and Peat, the Condition of Genesis, Occurrence, Gas Contents, Superficial Alteration, Spontaneous Combustion, Coke Formation and Hydrogenation By Prof B P Pentegoff Pp 32 In Russian, with Summary in English (Vladivostok) 50 kop

Report of the National Research Council for the Year July 1, 1927–June 30, 1928 Pp iii+95 (Washington, D C Government Printing Office)

Department of Commerce Bureau of Standards Research Paper No 64 Prism Refractometry and certain Goniometrical Requirements for Precision By L W Tilton Pp 909-930 10 cents Research Paper No 65 A new Determination of the Melting Point of Palladium By C O Fairchild, W H Hoover and M F Peters Pp 931 962 10 cents (Washington, D C Government Printing Office)

Department of Commerce Bureau of Standards Visitors' Manual of the National Bureau of Standards a Brief Account of its History, Functions and Laboratory Facilities (Miscellaneous Publication No 93) Pp ii+13 (Washington, D C Government Printing Office)

Publikationer og mindre Meddelelser fra Københavns Observatorium Nr 61 Asymptotische Losungen im restringierten Dreikorperproblem (Problème Restreint) Von Elis Stromgren Pp 55+1 Tafel (København)

Bulletin of the American Museum of Natural History Vol 58, Art 7 The Adaptive Modifications of the Arboreal Tadpoles of *Hoplophryne* and the Torrent Tadpoles of *Staurois* By G K Noble Pp 291-334+plates 15-16 (New York City)

United States Department of Agriculture Technical Bulletin No 111 Fish Oil as an Adhesive in Lead-Arsenate Sprays By Clifford E Hood Pp 28 (Washington, D C Government Printing Office) 10 cents

Japanese Journal of Geology and Geography Transactions and Abstracts Vol 6, Nos 3 4 Pp iii + 68 147 + 9-26 + 7 + plates 13-27 (Tokyo National Research Council of Japan)

Proceedings of the United States National Museum Vol 75, Art 16 A newly found Meteoric Stone reported by W B Lang from Peck's Spring, Midland County, Texas By George P Merrill, with Chemical Analysis by F A Gonyer (No 2787) Pp 2+1 plate Vol 75, Art 17 A new Nematode, *Sincosta aberrans*, new Genus, and new Species from a Rodent By Glenwood C Roe (No 2788) Pp 3+1 plate (Washington, D C Government Printing Office)

Sveriges Geologiska Undersokning Ser Ca, No 13 Nordmarks Malmtrakt, Geologisk beskrivning Av Nils H Magnusson Summary The Iron and Manganese Ores of the Nordmark District Pp 98 (Stockholm) 7 00 kr

Publications de l'Observatoire de Geneve Rapport sur les concours de reglage de chronometres de l'annee 1928 Pp 31 (Genève)

Treasury Department United States Public Health Service Studies on Oxidation-Reduction 13 Preparation of Indophenols which may be used as Oxidation-Reduction Indicators By H D Gibbs, W L Hall and W M Clark (Supplement No 69 to the Public Health Reports) Pp iii+35 10 cents 14 Equilibrium Potentials of 2, 6-Dibromobenzenone Indophenol-2'-Sodium Sulphonate, 2, 6-Dibromobenzenone Indophenol-3'-Sodium Sulphonate, 2, 6-Dichlorobenzenone Indo-2' Chlorophenol, and 2, 6-Dimethylbenzenone Indophenol By Wallace L Hall, Paul W Preisler and Barnett Cohen (Supplement No 71 to the Public Health Reports) Pp iii+26 10 cents (Washington, D C Government Printing Office)

CATALOGUES

A Catalogue of Important and Rare Books on Botany, Agriculture, Forestry, Fruit-Culture, Gardens and Gardening, Herbals, Early and Modern Medicine and Surgery, Tobacco (No 426) Pp 142 (London Bernard Quaritch, Ltd)

Art and Literature, including a selection from the Library of Sir Edmund Gosse (No 446) Pp 20 (Cambridge Bowes and Bowes)

Botany and Horticulture (Catalogue No 169) Pp 56 (London Dulau and Co, Ltd)

Diary of Societies.

FRIDAY, JUNE 21

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Cambridge), at 2 — L Yates The Evolution of the Sense of Hearing — J S Tucker Localisation of Sound — S Hett, Dr A G Wells, and Dr Murray Levick Ionisation as a Treatment for Middle-ear Suppuration — At 4 30 — Dr A A Gray The Application of the Principles of Maximum Stimulation to Clinical Otology — G Wilkinson Demonstration of a Model Resonator, Designed to Illustrate the Mechanism of the Cochlea

ROYAL SANITARY INSTITUTE (at North-East Coast Exhibition, Newcastle-upon-Tyne), at 2 30 — Dr H G Davison and others Discussion on The Problem of Feeding the Premature Infant — Dr E F Murray and others Discussion on The Need for a Maternity Service — Dr H H Evers and others Discussion on The Importance of Ante-Natal Supervision — At 4 30 — D. Boyd and others Discussion on Eliminating the Tuberculous Cow Administrative Results at Berwick-upon-Tweed — D W. Henderson and others Discussion on Hygienic Milk Supplies — C H Westwater and others Discussion on Clean Milk in the Northern Counties — At 8 — Prof L E Hill Smoke Pollution (Public Lecture)

ROYAL SOCIETY OF MEDICINE (Obstetrics Section), at 8 — G F Gibberd The Use of Animal Bladders for the Induction of Premature Labour — Prof Cleland and Drs Dawson, Wallace and Hackett Difficult Labour in Australian Aboriginal with Post-mortem Measurements of the Pelvis — C D Read and F Roques Some Results of the Surgical Treatment of Pelvic Endometrioma

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Annual General Meeting) (at 11 Chandos Street, W), at 8 15 — Induction of New President, Dr G Carmichael Low — Dr J F C Haslam Some Health Problems of British Guiana — Presentation of the Manson Medal to Sir Ronald Ross, and the Chalmers Medal to Major A C Sinton

ASSOCIATION OF ECONOMIC BIOLOGISTS (Annual Field Meeting) (at Cambridge) (continued on June 22)

SATURDAY, JUNE 22

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Cambridge), at 9 30 A M — M Vlasto The Chorda Tympani Nerve in Otology — C S Hallpike Some Observations on Bone Conduction — A R Tweedie Demonstration of Apparatus for Control of Conversation Test

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (at Nottingham), at 3

PHYSIOLOGICAL SOCIETY (at Plymouth)

MONDAY, JUNE 24

ROYAL GEOGRAPHICAL SOCIETY (Anniversary Meeting) (at Æolian Hall), at 3 — Presidential Address, Annual Report, and Presentation of Medals, etc

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 30 — Presentation of Royal Gold Medal

TUESDAY, JUNE 25

ROYAL DUBLIN SOCIETY, at 4 15 — Report of the Irish Radium Committee for the Year 1928 — H A Cummins, Violet C E Kennelly, and M Grimes A Study of Fungi found in Milk — P A Murphy Some Insect Vectors of Virus Diseases in Plants — L P W Renouf A Hydrographical and Biological Study of Lough Hyne, Co Cork — J Reilly (a) An Investigation of the Polysaccharides, Part I Inulin, (b) The Cryoscopic Constants of Acetamide — J H J Poole A Suggested New Type of Sensitive, Suspended Needle Galvanometer

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8 30 — Miss Beatrice Blackwood The Indians of British Columbia

INSTITUTION OF MECHANICAL ENGINEERS (at Manchester) (continued on June 26–28)

WEDNESDAY, JUNE 26

ROYAL SOCIETY OF ARTS, at 4 — Annual General Meeting

EUGENICS SOCIETY (at Royal Society), at 5 15 — Dr M C Buer Health and Prosperity in the Early Nineteenth Century

GEOLOGICAL SOCIETY OF LONDON, at 5 30 — R O Roberts The Geology of the District around Abbey Cwmhir (Radnorshire). — Dr C A Matley and Dr A Heard The Geology of the Country around Bodfean (South-Western Carnarvonshire) — Dr G H Mitchell The Petrography of the Borrowdale Series of the Kentmere Area (Westmorland)

THURSDAY, JUNE 27.

ROYAL SOCIETY, at 4 30 — Lord Rayleigh A Photoelectric Method of Measuring the Light of the Night Sky, with Studies of the Course of Variation through the Night — Prof J C McLennan, M W Perrin, and H J C Ireton The Action of High Speed Cathode Rays on Acetylene — T E Stern, B S Gosling, and R H Fowler Further Studies in the Emission of Electrons from Cold Metals — And other Papers

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8 30

FRIDAY, JUNE 28

PHYSICAL SOCIETY (at Imperial College of Science), at 4 45 — Dr Teresa J Dillon The Relation between Hydrogen Pressure and Filament Resistance in a Tube containing Glowing Tungsten — Dr Frances Lowater The Band Systems of Titanium Oxide — F E Smith The Absolute Measurement of Sound Intensity — A Demonstration of an Apparatus for the Measurement of Electrical Resistance at High Temperatures will be given by Dr J L Haughton

FRIDAY, JULY 5

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College, Gower Street), at 7 30 — Christopher T A Gaster Chalk Zones in the Neighbourhood of Shoreham, Brighton, and Newhaven, Sussex — H G Smith Some Features of Lamprophyres, near Sedbergh, Yorkshire

PUBLIC LECTURE.

WEDNESDAY, JUNE 26

UNIVERSITY OF BIRMINGHAM, at 4 30 — Dr C Singer The Modern Spirit in Medicine (II)

CONFERENCE.

JUNE 24 TO 27

BRITISH PHARMACEUTICAL CONFERENCE (in Dublin)

Monday, June 24, at 8 P M — Reception at the Mansion House

Tuesday, June 25, at 10 A M — Chairman's Address Reading of Science Papers

At 2 15 — Delegates' Meeting

Wednesday, June 26, at 10 A M — Science Meeting

At 11 A M — Delegates' Meeting

At 2 30 — Science Meeting

Thursday, June 27, at 10 A M — Closing Session

SATURDAY, JUNE 29, 1929.

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Editorial and Publishing Offices

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No. 3113, Vol. 123]

The New Museum Outlook.

THE museums of Great Britain are bestirring themselves, or, if that be putting it too strongly, at any rate many men of action and foresight are bestirring themselves concerning the museums. There is a museum feeling in the air. But in the midst of the reports and commissions, addresses and discussions which express this activity, the plain man may be excused if he fails to see that criticisms, suggestions, and counter-suggestions all point to a broad but tolerably well-defined road by which the museums of the British Isles must endeavour to make their way. The new road is the focus of many independent paths along which progressive museums have been feeling their way in recent years, often in face of difficulties, and scarcely realising that they were taking part in one of the great educational movements of the times. Though the reports have scarcely emphasised the magnitude of the change, it means a radical recasting of the museum idea and the adoption of a fresh museum outlook.

Here we propose to outline the fundamental change in outlook which progress demands, and to inquire whether recognition of the new objective may lead to suggestions for the development and control of existing museums.

In their historical origin, museums were simply conservatories, in the basic meaning of the word, houses for the storing and safe keeping of whatever was thought to be worth keeping, and their officers were and are 'keepers'. That is still looked upon as the primary and fundamental purpose of museums, and yet it is only in a few of the largest museums that the material is of a value so great or nature so irreplaceable that its conservation is of first and last importance. In the second stage of their development, museums condescended to show some of their possessions to favoured visitors, and finally to the public, but they placed the specimens just as they were accustomed to store them, in the arrangement most convenient for reference by experts. It is not so many years since a keeper in one of the national museums gave instructions that British birds (and that in a British museum) should be labelled with their Latin scientific names only. The attitude, and it was widespread, was that the public might learn if it could, but it was no purpose of the museum to teach.

That almost all the natural history collections in the museums which possess them are still arranged on the systematic lines of the expert taxonomist, is a relic of an early development, a convenient grouping for reference, easy for the museum officer

to arrange, and capable of infinite expansion Educationally, however, it is a passive arrangement. It permits the visitor, if he is receptive, to gain certain impressions of form and of relationship, but it is not designed to thrust new ideas upon him, to compel him to consider and reconsider. In a general way, that is typical of the old museum attitude to education; hitherto the museum has been an inactive educator, allowing the visitor to sip where he would, or go away dry if the nectar was not to his taste, but never, by one wile or another, compelling him to drink of the stimulating cocktails it might concoct

The new outlook which underlies the recent discussions regarding the museums of Great Britain, and towards which a few bright exceptions have been striving, is that museums must henceforward make it a primary duty to take an active and progressive part in the educational systems of the country. In a short preface to an American work dealing with the relationship between the American Museum of Natural History and the Educational authority of New York,[1] Prof. Henry Fairfield Osborn stated that "the growing museum influence, which during the past quarter of a century has been especially remarkable throughout the cities of the United States, is largely due to the recognition that the museum is not a conservative but a progressive educational force, that it has a teaching quality or value peculiar to itself, that the museum succeeds if it teaches, fails partially if it merely amuses or interests people, and fails entirely if it simply mystifies".

If only this could be set as an aim and end in the forefront of museum activities, the museums of Great Britain would take on a fresh lease of activity, and create for themselves a new and powerful place among the social institutions of the country, in no less degree than they have done in the United States of America.

In an address delivered a short time ago to the Royal Society of Arts and referred to in Nature (Feb. 9, p. 227), Sir Henry Miers sketched in broad outline the ways in which museum collections might be brought into relationship with educational stages. He founded his proposals on the assumption that museums should cater for four classes of visitors. For the ordinary visitor the history and resources of the town or district should be displayed; school children and students of riper years require summary collections and introductory series; for the collector and serious inquirer systematic collections are needful; and the researcher must have at hand great stores of classified material for investigation and comparison

Even this passive arrangement of museum exhibits falls short, however, of the needs of an active educational policy, such as the times demand, and such as has been attained by many of the museums in the United States As typical of these, glance at the activities, almost violent activities our sedate institutions would regard them, of the museums of the Brooklyn Institute of Arts and Sciences. In the course of a single year ten special exhibitions of various art collections and eight exhibitions of prints were arranged, and exhibitions of motion pictures portraying the 'Chronicles of America' and zoological subjects, as well as lecture courses for the public, for teachers and for students, were held. In addition, the Institute has specialised in a 'Children's Museum', with loan exhibits of natural history specimens for schools, with schools visits helped by three teachers assigned by the Board of Education, summer field trips, lectures, and so on. The detail with which the educational side is organised is indicated by many little refinements, such as the small cases of mounted birds which a child may borrow and take home as he would a book, the files of five thousand pictures and of trustworthy magazine articles, so catalogued that any set may be selected and borrowed by child or teacher, and the loan series of eight thousand lantern slides.

Is it desirable that the museums of Great Britain should reach towards such a goal? And if it is, is such a goal attainable? The consensus of opinion amongst educationists, the efforts already being made by the more progressive museums in this country, and the views expressed in or underlying recent reports and discussions, all point to the desirability of some such development, if museums are to escape from the backwash of stagnation and move with the main stream of the nation's progress. It may be said that the proper purpose of the great national museums is rather to attend to scientific interests than to cater for the education of elementary school children, but the argument is sufficiently met by the actual development of the American institutions, which have satisfied the demand for intrusion into educational affairs without losing a whit of their scientific enthusiasm or reputation

The question as to whether this desirable end is attainable is not so easily answered. Our opinion, however, is that it can be realised, but not under museum conditions as they generally exist in Great

[1] "Free Nature Education by the American Museum of Natural History in Co-operation with the Department of Education of the City of New York", by G H Sherwood, 1920

Britain to-day. An analysis of the difficulties will suggest lines along which development might well take place.

There is the fundamental difficulty of staffing. The teaching of young and old is an art based upon scientific principles, definitely recognised and the subject of specialised courses in universities and training colleges. It cannot be expected that the curators of museums, whether they be chosen for their general knowledge or for their expert skill in particular branches of science, can be at the same time, barring a few exceptional cases, in close touch with educational developments and the needs of elementary, secondary, and advanced education. Even if they knew the demands, they cannot be expected to be familiar with the technique and progress of modern educational methods.

It is evident, therefore, that a scientific museum staff is not best fitted for the carrying out of an educational policy, quite apart from the fact that in the larger museums the scientific staff is already overburdened with its own particular problems. If the museum share in educational progress is to be more than a mere nibbling at the fringe of a great problem, new qualifications and new personnel must be drafted into the scheme Moreover, this change must take place with as little disturbance of existing arrangements as possible ; for it is recognised that, for the purposes which they now serve, the greater museums are working competently and smoothly. There must be no uprooting of a well-established growth , the educational shoot must be grafted upon the present sturdy museum plant.

These considerations suggest one or two broad lines of change which might well herald the adoption of an active educational policy There must be a mutual approach between the museum body and the educational body. This *rapprochement* would develop in two directions, one affecting the framing of general museum policy and the other the actual development of the policies decided upon. In the first case, the governing body of the museum, whether it be an *ad hoc* committee of the county or municipality, the council of a naturalist society, or an advisory body of whatever origin, would be strengthened and broadened in outlook by the inclusion of one or more of the leading educationists of the district, selected for their capacity in dealing with new problems as well as for their knowledge of educational needs. It would be strange indeed if, on such a body, discussions between men of general culture, educational specialists, and representatives of the museums themselves did not evolve new suggestions worthy and capable of being carried out.

The carrying out of the schemes so formed leads to our second consideration. On one hand museum staffs must co-operate with educational authorities, and on the other, educational authorities must make more use of museums On the lowest scale, this implies that exhibits of museum materials will be arranged in such a way that they can be used, simply and easily, to illustrate the Nature study lessons of the schools, and that school authorities will support the effort by making full use of the museum But on a higher scale, and in the large museums, it would imply much more, as the activities of the Brooklyn Museum foreshadow. The large museum would play its part by appointing a staff specifically to deal with educational activities , the educational authorities would detail certain of their teachers to conduct school parties in the museum, give museum lessons, and so on.

In whatever way it may be accomplished and whatever degree of development it may reach, the closer association between museums and formal education is an end eagerly to be desired ; it would inevitably lead to fresh lines of usefulness for museums already flourishing, and might spell a new life for many institutions now all but moribund. The passive, dead-and-alive museum is like a bank which, having collected the moneys of its customers, exhibits a few samples of currency in its windows and locks the remainder in its strongholds. It is not the receipt and storing of money or of specimens, but the use made of them, that means success for bank or museum. That is, in effect, our plea for the deliberate adoption, in museums large and small throughout Great Britain, of the new museum outlook

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Mathematical Physics.

Mathematical and Physical Papers By Sir Joseph Larmor. In 2 volumes. Vol. 1. Pp. xii + 679. Vol. 2. Pp xxxii + 831. (Cambridge: At the University Press, 1929.) £6, 6*s*. net.

THESE volumes contain the contributions made by the author to different scientific societies and periodicals during a period of nearly half a century, and the subjects treated of extend to almost every branch of physical science. The author observes in his preface that "every investigator bears the stamp of the domicile in which he has been brought up ". In the present case there are two domiciles ; to the first is probably traceable the influences of Hamilton and MacCullagh. The

second, beginning at Cambridge towards the end of the period which saw the rediscovery of Green's work, the publication of Thomson and Tait's "Natural Philosophy", and the publication of Maxwell's treatise on "Electricity and Magnetism", has also had its influence, both in the selection of the subjects of investigation and on the method of treatment.

One of the outstanding events of the period was the recognition of the importance of the Lagrangian method as the means of investigating not only the problems of mechanics but also the problems of physical science in general. The memoir by Green on the reflection and refraction of light is possibly the earliest in which the conditions for the successful application of the method to a physical problem are set out clearly, although not infrequently too much trust has been placed in his statement—"that but little effort is required on our part"—while the caution implied in the earlier part of the passage quoted from is overlooked.

By 1880 the value of the method in the investigation of the problems had been fully recognised, and had become the usual method of investigation for these problems. The method naturally plays an important part in the present collection. In the paper "On Least Action as the Fundamental Formulation in Dynamics and Physics" (*Proc Lond. Math. Soc.*, 1884) the method is applied with success to a great variety of problems both in mechanics and physics, and the mathematical connexion between them is established The same method is applied to the problem of "the flow of electricity in a system of linear conductors", leading to a very general solution of the problem. In the first 400 pages of the first volume there are papers on subjects in pure mathematics, optics, and electricity of varying length and importance, but all of interest. The British Association Report (1893) on "The Action of Magnetism on Light; with a Critical Correlation of the Various Theories of Light Propagation" gives an account of the different theories which had been proposed to account for the phenomena accompanying the propagation of light up to the time of its preparation, and compares them carefully, at the same time making various suggestions and removing some of their obscurities. This report is the forerunner of the series of three papers "On a Dynamical Theory of the Electric and Lumiferous Medium" published in the *Philosophical Transactions*.

The first of these papers appeared in 1893, and its central feature is the identification of the electric energy function with the energy function developed by MacCullagh in relation to optical phenomena This energy function had been arrived at by adopting a procedure which was the converse of the procedure adopted by his predecessors

The elastic solid theory of light propagation as developed by Green, Cauchy, and others had provided an adequate representation of the phenomena of the reflection and transmission of light in the case of isotropic media, but had failed to give results which were in agreement with Fresnel's results in the case of anisotropic media. Green and Cauchy had proposed to overcome this difficulty by the introduction of extraneous forces MacCullagh set out to discover the energy function which would satisfy Fresnel's laws both for isotropic and anisotropic media. Later, Kelvin showed that the energy function built up by MacCullagh was that of a quasi-labile elastic medium or of a gyrostatically loaded medium, hypotheses which are not unrelated to the hypotheses of Green and Cauchy In the author's paper of 1893, this energy function having been identified with the electric energy function is applied and tested for a great number of different phenomena. In particular, the result is obtained that the velocity of propagation of light is affected by a magnetic field Experiments carried out by Sir Oliver Lodge showed that the effect, if any, is so small as to be incapable of detection. Two conclusions can be arrived at as the result of these experiments, either the luminiferous medium is fixed or stagnant, or the energy function which leads to this result is defective The author has chosen the first of these alternatives, but it may be observed that the direct application of Faraday's laws to the problem of the effect of a constant magnetic field on the velocity of the propagation of light gives the same result as these experiments, namely, that there is no effect.

The problems of magneto-optic rotation and radiation are discussed on this theory, and with the introduction of a dissipation function, the circumstances of the reflection of light by metallic media are investigated

In an appendix the theory of electrons is introduced and applied to some of the cases; in particular, the theory of natural magnets is treated from this point of view, and also optical dispersion In the second paper (1895) the theory of electrons is developed to a greater extent, and is applied to the investigation of the phenomena which depend on the molecular or atomic properties of material media In addition to the phenomena discussed in the first paper, the propagation of light in metals, conduction currents, the mechanical electro-dynamic

forces acting on a conductor, the problems of a conductor rotating in a symmetrical magnetic field and the conjugate problem of a rotating electrified conductor are considered, as also the pressure of radiation The null result of the Michelson-Morley experiment is discussed on this theory, and explained in terms of what is now usually referred to as the Lorentz transformation.

In his memoir "La théorie électromagnétique de Maxwell et son application aux corps mouvants" (1892), and in a later memoir (1895), H A. Lorentz developed a theory of electrical and optical phenomena similar to the theory presented in the present volumes The energy function, which is fundamental in both cases, is the same, and although the treatment, more especially where statistical processes are involved, is somewhat different, the results obtained, when the phenomena discussed are identical, are naturally for the most part in agreement The particular form of the transformation arrived at in the case of a material body moving with a uniform velocity, from which the later development known as the theory of relativity, has arisen, is an inevitable consequence of the form of the energy function which is the basis of the theory of a stagnant ether; but there are difficulties connected with this theory which, so far, do not appear to have been surmounted. For example, is the Lagrangian method applicable to the comparison of two systems, when the space co-ordinates of the one involve the time co-ordinate of the other, and the time co-ordinate of the first involves the space co-ordinates of the second? Furthermore, it has been proved that, if Faraday's laws are applied to the case of a material body moving with a uniform velocity, the axes of reference for Faraday's laws being the same as the axes of reference for the moving body, the relation between the moving body and a body at rest relatively to the same axes is that the moving body is contracted in the ratio $(1-u^2/c^2)^{\frac{1}{2}}$ in the direction of its motion, and no transformation involving the time co-ordinate is involved

In the third paper of the series the theory of electrons is restated and its application to material media is more extensively developed. The investigations of the two previous papers are revised in some cases, the relation of the theory to the kinetic theory of gases and to radiation is investigated, a general theory of optical dispersion is set out, and the problem presented by absorption bands is discussed. Thermodynamics, osmotic pressure, the laws of chemical equilibrium, paramagnetism and diamagnetism are also discussed, and the mechanical relations of radiation are re-investigated.

Whatever the ultimate verdict on this theory of the ether, which is the basis of these papers (afterwards with additions and revisions embodied in the author's "Æther and Matter"), may be, it offered a possible and promising line of advance, it is in agreement with a greater number of physical phenomena than its predecessor the elastic solid theory of the ether, and the author's contributions to it are very notable. There are subsequent papers on other applications of the theory, the Zeeman effect, the optical influence of a magnetic field, etc., all additions of interest to the subject.

There are several papers on geophysics, an interesting paper on Huygens' principle, various reports and addresses, but probably the most important papers in the collection other than the electrical papers are the papers on thermodynamics and the theory of gases The author has expressed a doubt as to whether the time is ripe for the formulation of a history of electrical theories; this, despite the many treatises on thermodynamics and the kinetic theory of gases, is true in some measure of the theories connected with these latter subjects. These volumes, however, contain valuable contributions in this direction, and in a connected form would go far to supply such a history.

A detailed examination of the different papers in the two volumes is impossible within the present limits, but it may be observed that they contain contributions of interest and value to most of the questions which have been prominent in physical science for the last half-century. By collecting them together so as to make them readily accessible to other scientific workers, the author has earned their gratitude, and the care with which they have been edited and printed reflects great credit on the author and on the Cambridge University Press.

One Hundred Years of the 'Zoo'.

Centenary History of the Zoological Society of London. By P. Chalmers Mitchell Pp. xi + 307 + 33 plates + 9 plans (London Zoological Society of London, 1929) 25*s*.

BY its 'Zoo' is the Zoological Society of London known to the people; its zoological gardens have given it a hold upon the nation which no purely scientific activity could have gained; and the progress of the Zoo is the touchstone by which its success will be tested, at any rate by the superficial Yet from the outset of its career two distinct and almost antagonistic aims lay at the hearts of

the founders of the Zoological Society and were embodied in its charter on one hand the popular appeal of the introduction of "new and curious subjects of the Animal Kingdom", and on the other the sternly scientific "advancement of Zoology and Animal Physiology". It is perhaps the greatest triumph of its hundred years of existence that the Society has cherished these two objects with equal favour, developing its gardens to their utmost limits and at the same time making vast contributions to the progress of knowledge. It has done more; it has blended a double function which might have split the Society to its roots into a harmonious whole, so that the Zoo has become the patron of science, contributing handsomely to its coffers, and science, the handmaiden of the Zoo, has eased the conditions of its inmates, and furthered their welfare in the details which make life in captivity worth living.

In his "Centenary History", Sir Peter Chalmers Mitchell traces with easy knowledge the multifarious lines of activity which have coalesced to make the Zoological Society and its Zoo what they have become. The Society owes its origin in 1826 to Sir Stamford Raffles, who lived just long enough to see it well on its way to success Its earliest stages were recently discussed in an article in NATURE (May 4, p 687), so that no further reference to its foundation need be made, except that it is desirable to point out that, following Scherren's "The Zoological Society of London" (1905), undue weight was there placed upon the part taken by the Zoological Club of the Linnean Society Chalmers Mitchell has investigated this and many other controversial points with minutest care, and the pains which he has evidently bestowed upon the consultation of original sources of information ensure that his is the last word in these matters

Since the Zoo is the hub of the system, let us glance at the major developments which have kept it in the centre of public favour. The chart which forms a frontispiece to the volume, and in itself is a mine of information, shows plainly that an unprogressive policy is reflected in stationary or dwindling audiences The fresh appeal of the original gardens soon wrought itself out and was followed by a steady decline in numbers of fellows, in numbers of visitors, and in income, which must have caused deep concern to those in authority. Now a glance at the series of plans of the gardens at different stages of development, appended to the volume, shows that since the first concession of twenty acres in 1826, there has been a gradual extension of area to more than double the original size. But the chart reveals no connexion between increasing prosperity and mere accretion of acres. On the other hand, it clearly demonstrates that the secret of success from the public point of view is the staging of special features, which not only attract a temporary fresh influx of visitors, but tend to raise subsequent attendances to a new base level

Accidental influences, such as the Great Exhibition of 1851 or the International Exhibition of 1862, are naturally enough reflected in the numbers of visitors to the Gardens, but the lesson of the chart is that special efforts at display meet a rich reward. Royal collections of animals, since that first exhibited by the Prince of Wales in 1876, have always been exceedingly popular, but the organised works which have brought overwhelming success are the Mappin Terraces in 1913, the Aquarium in 1924, the Reptile House in 1927, and the Bird House in 1928. Taking the appointment of the present secretary in 1903 as a convenient datum line, it is a remarkable testimony to his progressive policy that in the quarter of a century which has since elapsed, the number of fellows has more than doubled, annual income has trebled, and the number of annual visitors has increased almost fivefold

Keeping step with these popular developments have been no less important changes which appeal perhaps more strongly to the scientific observer, notably the vital innovation from the stuffiness of closed and warmed cages to natural temperatures and open air, the introduction on a large scale of radiant heat for the animals, and, a great step in progress, the acquisition of Whipsnade Park and the planning there of scenic panoramas and paddocks on the most advanced lines

Of the purely scientific activities of the Society we have left ourselves no space for comment. The *Proceedings* and *Transactions*, which are stocked with results based largely upon the collections themselves, are as indispensable to the scientific worker as is the "Zoological Record" and the one-time museum, notable for the large proportion of type and historic specimens which it contained, on its dispersal enriched the Natural History Museum at South Kensington, and to a lesser extent other institutions

The century, not without its dissensions and difficulties, has been one on which the Zoological Society and the nation can look back with pride, and from which they can look forward with confidence in a strong guidance, enlightened by scientific knowledge and enriched by the naturalists' wide sympathy with living things. J. R.

Alpine Tectonics.

The Nappe Theory in the Alps (*Alpine Tectonics, 1905–1928*). By Prof Dr Franz Heritsch. Translated by Prof P. G. H Boswell (Methuen's Geological Series) Pp xxx + 228 + 8 plates (London. Methuen and Co, Ltd., 1929.) 14*s* net.

THE existence of great overthrusts in the Alps was recognised by Escher von der Linth in 1853, and by von Richthofen in 1859, and was proved from the mining at Idria by Lipold in 1874; but it was only after the work of Schardt in 1894 that these displacements were generally accepted and explained as nappes. Nappe is the French word for a sheet, but the term is used in Alpine geology, as in the title of this book, as an abbreviation for a *pli-nappe* or *nappe de recouvrement*, or over-folded sheet Such nappes are explained as due to flat-lying folds from which, as they are pushed forward, the central limb is ground to powder and worn away According to the advocates of the theory, the nappes in the Alps cause horizontal displacements that are well established for 60 miles, while the total movement may be much greater; for some of the mountains seen from the terrace at Berne are regarded as parts of Africa pushed into central Switzerland

The difficulty of the subject to British students is increased by its scattered literature and special technical terminology. The book by Prof Heritsch of Graz, therefore, should prove of great service, as a guide to the modern literature on the Alps, especially on the Eastern Alps, and as a statement of the evidence for and against the nappe theory. The work has been extended and revised by help of the author during the translation, which in several respects is an improvement on the original. It has additional illustrations, and the excellent glossary which has been prepared by the translator will, it may be hoped, standardise the English equivalents of many of the tectonic terms.

The attractiveness of the nappe theory depended upon its seductive simplicity. The alternative explanations are often complex. When, however, the theory is followed into details, the simplicity disappears owing to rapid changes in the hypothesis, extreme differences of opinion among its supporters, its evasiveness of crucial tests, and fantastic explanations introduced to explain special cases. The theory is often dependent upon uncertain identifications of the age of the rocks. For example, the Matterhorn consists of a pyramid of gneiss resting on schists which are regarded as altered Trias. If this age of the basal schists is incorrect, the upper part of the Matterhorn need not be explained as a far-travelled erratic Similarly with the Hohe Tauern in the Eastern Alps, the nappe theory there depends on the identification of part of the schists as Trias, but if they are pre-Cambrian the application of the theory to the Tauern is invalid.

The difficulties of rock identification are met by the assumption that the differences between various parts of the same sheet are due to differences of facies For example, the rocks identified as the southern root of the Silvretta nappe form the hills east of the northern end of Lake Como These rocks are so different from those of the Silvretta as to suggest doubt as to their belonging to one sheet. This difficulty is circumvented by the assumption that the differences are due to the rocks having been deposited so far apart that they occur in different facies This facies argument, as remarked by Prof Boswell in the preface, is naturally regarded with suspicion by British geologists, who are used to the rapid lithological changes among our Jurassic deposits The extreme movements claimed have not been supported by the discovery in the Alps of the characteristic North African facies of the Eocene or Cretaceous

The nappe theory is faced by serious physiographic difficulties According to some estimates, the nappe movements in the Miocene and Pliocene must have piled up rocks to a thickness of about 20 miles above the Alps All this material must have been since removed by denudation, and there is no trace of the debris on an adequate scale in the surrounding areas Another physiographic difficulty, to which attention was directed by Prof. Bailey Willis in 1912, is that there are in the Alps old land surfaces that date from the Lower Miocene and even earlier, and their existence, Prof Heritsch remarks, is quite irreconcilable with the supposed later nappe movements Such difficulties have been often ignored by the supporters of the nappes, who, in their enthusiasm, regard the evidence in favour of the theory as so convincing that they are confident that explanations of these difficulties will appear.

The special merit of Prof. Heritsch's book is that it states the issues impartially, and by directing attention to the difficulties and uncertainties in the nappe theory, should guide the discussion to the critical points, and thus help in the solution of the problem The book is not easy reading, owing to its conciseness and brief statement of views of bewildering variety. It should, however, prove indispensable to students of mountain structure as a guide to current Alpine literature and opinion.

Our Bookshelf.

An Introduction to the Study of Ore Deposits By Dr. F. H Hatch. Pp. 117. (London George Allen and Unwin, Ltd , 1929.) 7*s*. 6*d*. net.

MOST books devoted to the study of ore-deposits suffer from an attempt to give too much detail It is manifestly impossible to write an account of the mining fields of the world in small compass, and Dr. Hatch has not attempted this. He has set himself the ideal of producing a real introduction to the subject, elucidating everywhere the general principles by illustrations taken from actual instances, and it must be said that in this he has been extremely successful. Many of the examples are naturally chosen from his own experiences in different parts of the world, and the outcome is an admirable instance of the application of scientific ideas to a truly practical subject.

The first chapter is an interesting historical summary of theories of ore-genesis, largely based on the author's presidential address to the Institution of Mining and Metallurgy in 1912, but brought well up-to-date. The next nine chapters are concerned with the different processes of ore-formation and alteration, the last-named being of course a matter of the greatest practical import, in such matters as zones of oxidation and of secondary enrichment Chap ix deals with the origin of residual deposits of all kinds, including the laterite-bauxite group and manganese deposits, as well as residual ore-bearing gravels. It is pointed out that in the tropics so-called alluvial propositions are often in reality rock in place, so deeply decomposed as to be workable by hydraulic methods. The last chapter deals with the forms of ore-bodies, and there are no less than four indexes, of authors, localities, minerals, and a general index of subjects.

This book may be strongly recommended as being what it was intended to be—a real and valuable introduction to the study of mining geology. R. H. R.

Denkschriften der Schweizerischen Naturforschenden Gesellschaft (*Mémoires de la Société Helvétique des Sciences Naturelles*). Band 64, Abh. 2: *Nouveau catalogue des moules d'échinides fossiles du Musée d'Histoire naturelle de Neuchâtel* Exécuté sous la direction de L. Agassiz et E Desor par J. Lambert et A. Jeannet. Pp. ii + 83-233 + 2 planches. (Zurich Gebrüder Fretz A.-G., 1928.)

ABOUT 1838, Louis Agassiz had assembled in Neuchâtel specimens of fossil sea-urchins borrowed from various public and private collections to aid him in his "Monographies d'échinodermes". Many of these specimens became the types of his new species , all were authenticated ; and he conceived the happy idea of making plaster moulds from them and of distributing the casts to museums or students interested in the subject. After Agassiz left Neuchâtel, the good work was continued by E. Desor and later by H. Michelin, down to about 1858, when the number of species thus represented amounted to 960 A second edition of the casts was begun in 1854 by L Coulon, who had succeeded to the direction of the Neuchâtel Museum. It is to be feared that after a time in many museums these valuable documents of research, having become dusty, lost the respect of a new generation of curators and were not kept in order. Even at Neuchâtel itself, the present director "found the casts piled up at random in two large boxes and sometimes spoiled "

Such being the state of things, all serious students of the Echinoidea should be most grateful to Messrs. J Lambert and A Jeannet for an extremely careful inquiry into the history of the series, the provenance and ultimate location of the originals, the distribution and fate of the casts, and above all for the annotated list of the species represented In this list each entry gives the name under which the cast was issued, the subsequent nomenclature of the species, the horizon and locality of the original, with references to descriptions and figures of the specimen. In short, nothing seems missing from this *apparatus criticus* F. A B.

Three Lectures on Neurobiotaxis and other Subjects, delivered at the University of Copenhagen. By C U. Ariens Kappers Pp 76 (London William Heinemann (Medical Books), Ltd , 1928) 7*s*. 6*d*. net.

THE Lancashire Asylums Board was recently assured by its officers that persons equipped for neurological research would not now be forthcoming in England, even were money available to employ them If this extravagant statement must be set aside as merely an item in official ' conversations ', it is unfortunately true that Great Britain has now fallen far behind its continental neighbours and America in this direction It is therefore to be hoped that these lectures will have a wide circulation among British readers, in whom neurological interest may thereby be reawakened

The theory which Dr. Ariens Kappers develops in the first of the lectures was first advanced by him more than twenty years ago, and has suffered misunderstanding in Great Britain owing to confusion with the chemotaxic explanation of nerve development proposed by Ramón y Cajal. Thus, even so acute a critic as Elliot Smith has put forward Kappers's own principle—one of relative growth at critical moments of development—while implicitly rejecting the theory as unnecessary (Cunningham's "Textbook of Anatomy ").

The present lucid treatment lays stress on simultaneity of function as the essential principle underlying anatomical correlations in the nervous system, and extends the theory to cover a variety of freshly observed instances, particularly some of the baffling phenomena of the decussation of fibre-tracts. It is possible to appreciate the far-reaching and illuminating character of the principle of neurobiotaxis without, however, endowing it with causal significance as Dr Ariens Kappers does on p 36 The last of the three lectures is a brilliant account of the development of the cerebral cortex in terms of neurobiotaxis.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications.]*

Solutions and Heat Engines.

MAY I add a word to the discussion on osmotics? As regards the osmotic pressures of mixed gases I would point out that the reviewer's case (2) (NATURE, April 13, p 569), where two atmospheres of nitrogen are inside the chamber and one atmosphere of hydrogen is on each side, is not in osmotic equilibrium if there be any interaction between the molecules of nitrogen and hydrogen: the equilibrium will obtain, so it seems to me, only when the partial pressure of the hydrogen equals its pressure outside, and we have, as yet, no means of calculating this effect.

With liquid solutions a little consideration will convince one that there are a multitude of formulæ, functions of the concentration, which will fit the facts for dilute solutions Among these may I direct attention to one which seems promising?

If the observations of Berkeley, Hartley, and Burton (*Phil. Trans R.S*, vol. 218) on the osmotic pressures of cane sugar and α methyl glucoside are tabulated, as below, against the weight concentration multiplied by the density of the solution, squared, the figures agree to about 5 per cent.

CANE SUGAR								
	At 0° C				At 30° C.			
c_2/c_1	O P.	Ratio of O P.'s	d^2	Ratio of $d^2 \times c_2/c_1$.	O P	Ratio of O P.'s	d^2	Ratio of $d^2 \times c_2/c_1$
	Atm				Atm			
0 3400	..	.	.	.	26 82	1	1 216	1
0 5650	43 91	1	1 357	1	47 25	1 76	1 333	1 83
0 8120	67 43	1 54	1 468	1 56	72 59	2 71	1 439	2 82
1 1200	100 53	2 29	1 580	2 30	107 55	4 01	1 548	4 18
1 4100	134 86	3 07	1 667	3 08	143 33	5 34	1 632	5 56
1 8300	186 86	4 26	1 768	4 21	198 89	7 42	1 730	7 64
2 1750	230 70	5 25	1 835	5 20	249 16	9 29	1 796	9 47
2 4300	264 46	6 02	1 877	5 93	.	..	.	.
α METHYL GLUCOSIDE								
	Atm				Atm			
0 3500	48 29	1	1 199	1	49 42	1	1 179	1
0 4500	64 22	1 33	1 245	1 34	65 14	1 32	1 222	1 34
0 5500	80 50	1 67	1 287	1 68	81 73	1 65	1 262	1 68
0 6400	96 17	1 99	1 310	1 99	96 75	1 96	1 294	2 01
0 7500	115 74	2 40	1 361	2 44	115 34	2 33	1 331	2 42
0 9000	142 46	2 95	1 408	3 00	141 66	2 87	1 375	3 00
1 0500	170 18	3 52	1 451	3 60	168 34	3 41	1 415	3 60

NOTES —c_2 and c_1 are the concentrations, *i e* number of grams per gram of solution, d is the density of the solution compressed to its osmotic pressure

It is easy to see that the osmotic pressures must be a function of the density; for consider two cylinders containing different solutions and furnished at the bottom with semi-permeable membranes which just touch the surface of the solvent. If we neglect the stratification caused by the gravitational field, then, when there is equilibrium across the membrane, $P = hd$ where P is the osmotic pressure, d the density of the solution, and h its height, hence

$$\frac{P_1}{P_2} = \frac{h_1 d_1}{h_2 d_2}.$$

An explanation of the weight concentration part of the formula can be put forward. Assume that the solute takes no part in the bombardment of the membrane, that is, this bombardment is conditioned only by the solvent molecules. It will be necessary, therefore, to put a pressure on the solution to increase the speed of the solvent molecules such that the number striking the membrane per second on the solution side will be equal to the number on the pure solvent side. It is easy to see, if our solution is an ideal one (that is, there is no interaction between the two sets of molecules and therefore there is no change in volume when the *liquid* substances are mixed), that this pressure will be proportional to c_2, and, if we remember we are dealing with a *defect* in bombardment, it will roughly be inversely proportional to c_1. The c's are the number of grams of solute (c_2) and solvent (c_1) in one gram of solution—and c_2/c_1 = weight concentration/100

Obviously this explanation is but a rough approximation to actual conditions, but, if the formula applies to substances other than the sugar type of molecule, we have a rule-of-thumb means of calculating both osmotic pressures—a matter of some importance as they are just as much physical constants as the density or refractive index.

A little thought will make it evident, if we remember that we are still considering an ideal solution, that we could have put $c_2/c_1 = v_2/v_1$ (where v_2 and v_1 are the volumes of the respective components in 1 c.c. of solution), and we should have had a more consistent formula. But with the v's[1] of the actual solutions the results are not so good—they only agree to 15 per cent; this is not to be wondered at, for we have not taken into consideration the molecular interaction nor the effect due to closeness of packing. I think, however, that these two considerations can be allowed for if we may assume that when one molecule strikes another the rebound is not instantaneous and a 'rest period' ensues, the effect of closeness of packing may turn out to be a function of the density, but I have not the means at hand for calculating this. I hope to return to the matter in another communication.

BERKELEY.

[1] These are derived from Porter's (*Proc Roy Soc.*, 1908, p 460) definition of his s_2 and s_1

Determination of Crystal Potentials by Diffraction of High Voltage Electrons.

WHEN electrons are diffracted by a crystal cleavage face, Bragg's law, on taking account of the refractive index of the crystal for the electron waves, becomes $n\lambda = 2d \sin\theta \sqrt{1 + \frac{\mu^2 - 1}{\sin^2\theta}}$, or, putting $\mu = \sqrt{1 + \frac{\phi}{V}}$ and $\lambda = \frac{h}{mv} = \sqrt{\frac{150}{V}}$ A., where ϕ is the inner potential of the crystal and V is the energy of the electrons in volts, we obtain

$$\sqrt{V} \sin\theta = \frac{n\sqrt{150}}{2d} \sqrt{1 - \frac{4d^2\phi}{150 n^2}}. \qquad (1)$$

For a spacing 4 A. the first order will thus disappear entirely for ϕ as small as 2 4 volts, whatever the value of V This wide variation from Bragg's simple law, then, will be quite as marked for high as for low voltages, and since swift electrons are less liable to be deviated by stray fields, etc, the high voltage method ought to be the more suitable for determining ϕ. The surprisingly large effect of refractive index at these high voltages depends on the very small angles of refraction which occur, and is only strongly marked when the reflecting plane is the free surface of the crystal. This effect has been pointed out by Prof. G. P. Thomson (*Phil. Mag.*, **6**, p. 939; 1928).

Strong spots were obtained on a photographic plate by diffraction from the cleavage faces of calcite (1, 0, 0), galena (1, 0, 0), and antimony (1, 1, 1) For each spot the product $\sqrt{V} \sin \theta$ was constant within the limits of experimental error for the range 10 to 45 kv., but spacings calculated for $\phi = 0$ differed widely from X-ray determinations.

In the case of calcite there were two spots on the equator line. Photographs were taken of each, a willemite screen being used in setting the crystal at the correct angle. Substituting the values of $\sqrt{V} \sin \theta$ in equation (1) and taking the spots to be the nth and $(n+1)$th orders, we get two equations to determine n and ϕ These give $n = 3$ and $\phi = 22$ volts, and for this value of ϕ the first and second orders disappear.

Galena gave one spot on the equator and two other spots vertically above and below it, that is, parallel to the axis of rotation, which was a cube edge. The latter spots were too near the equator line to be due to reflection from any of the geometrically possible planes of the crystal if refraction took place at the (1, 0, 0) plane Good agreement was obtained, however, by supposing the crystal surface to be rough and refraction to take place at the plane producing reflection This being the case, the spot on the equator line had to be taken as (6, 0, 0) and the spots above and below it as (6, 0, 2) with ϕ equal to 18 2 volts. The plates also showed faint vertical lines at positions corresponding to (8, 0, 0) and (10, 0, 0) for the above value of ϕ. The accompanying reproduction (Fig 1) is a galena photograph showing the equatorial spot and the fainter spots vertically above and below it. The part of a circle on the extreme right is where the scattered electrons are cut off by the camera.

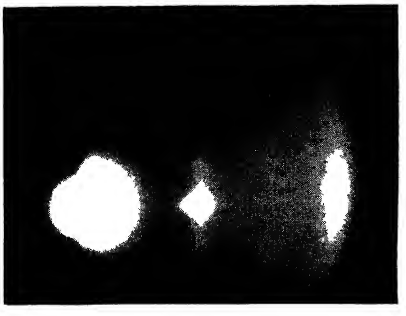

Fig. 1.

The pattern from antimony was similar to that of galena but less well marked, the spots above and below the equatorial spot being too faint to measure For the spot on the equator line n was so chosen that the corresponding value of ϕ made the $(n-1)$th order disappear, whence $n = 4$, $\phi = 25$ volts

In the calcite photographs, but not in those of antimony and galena, in addition to the spots there were a number of crossing lines, which were obviously similar to those obtained by Kikuchi (*Proc. Imp. Acad. Jap.*, **4**, p. 475 ; 1928)

No great accuracy is claimed for the above results, the experiments being of a preliminary nature, but the rapid variation of $\sqrt{V} \sin \theta$ with ϕ indicates that the method may be of importance for precise measurements of the inner potential of crystals.

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Luminous Discharge in Gases at Low Pressures.

If the Lecher circuit previously employed for generating a luminous discharge in electrodeless tubes by electric oscillations of high frequency—20,000 kilocycles or more—(Nature, **123**, p. 346 ; 1929), is exchanged for short coils, the luminosity can be much increased. By the same means it is possible to make the discharge pass through narrow quartz capillaries less than a millimetre in width, thus realising a source of light which has the linear shape suitable for spectrography, and moreover requires a very minute quantity of the gas to be examined.

With a plate current of, say, 50 milliamperes at an anode potential of 1000 volts, the light emitted from nitrogen or from the oxides of carbon under these conditions is so intense, that an exposure of thirty minutes or even less suffices for giving with a large quartz spectrograph a fully developed band spectrum in the ultra-violet. With the inert gases the luminosity is very intense, especially with neon, which gas can be excited to give light of an intensity almost insupportable to the eye both in narrow capillaries and also in wider tubes introduced within the coil through which the discharge is passing. Experiments which have still to be carried out will show whether krypton excited by this means in electrodeless tubes will be suitable as a source of the line at 5649 A., recently proposed for a new standard of wave-length

Carbon monoxide and dioxide both show a rapid dissociation when subject to the oscillatory discharge. Probably for this reason my attempts to separate their spectra by the flow method have so far failed. Carbon monoxide excited when passing through a narrow capillary at a velocity of 5 metres per second gives a deposit of carbon, which in the course of a few minutes obscures the light and finally intercepts the discharge. Hydrocarbons from tap-grease, if once happening to be present within the tube while the discharge is passing, also give a carbon deposit, which no subsequent baking out of the tube in a high vacuum will remove, only burning out by protracted discharge with air or oxygen within the tube. If the discharge is made to pass through a tube contaminated in this manner at a low pressure, the oxygen produced from the disintegration of silica is largely converted into oxides of carbon which emit the white light erroneously ascribed to ozonised oxygen in my previous communication (loc cit.).

In my spectrograms from the oxides of carbon excited in this manner, all the Deslandres bands belonging to the first negative carbon spectrum falling between 2300 A. and 2900 A., as measured by R C. Johnson (*Proc. Roy Soc*, London, A, **108**, p. 343 ; 1925) have been identified, and an additional number of fainter bands of similar structure. The double bands near 2896 A. and 2883 A. show conspicuous variations in intensity on different spectrograms, which lends support to the view that their origin is different from that of the other bands of the series, which have also a different structure. Compare the work of Fox, Duffendack, and Baker (*Proc. Nat. Academy*, Washington, **13**, p. 302 , 1925), who have found these two double bands to be due to carbon dioxide.

The red fluorescence from quartz or glass excited by the oscillation I now find to have been previously noticed by Wood and Loomis (Nature, **120**, p. 510; 1927) and also by McCallum (*ibid.*, **121**, p. 353 , 1928), whose communications had escaped my notice. The view of the first-named authors that this fluorescence is in some way due to excited molecules or ions of oxygen is no doubt correct, as can be beautifully demonstrated by deflecting with a strong horse-shoe

magnet the egg-shaped luminosity of greenish-yellow colour which is formed between the electrodes in a discharge-tube of wider diameter containing pure oxygen at low pressure. At the points where the deflected egg is brought near to the wall, two patches of brilliant red appear, separated by narrow, dark inter-spaces from the rim of gold-coloured fluorescence next to the electrodes. With other gases quartz fluoresces in the deep blue or violet, sometimes in the green, whereas the red fluorescence, corresponding to a band near 620 $\mu\mu$, is only observed with oxygen at low pressure. HANS PETTERSSON.

Structure of the Band Spectra of the Hydrogen and Helium Molecules.

IN the spectrum of the hydrogen molecule many regularities have been found recently, especially by Richardson and his co-workers. In a note in the *Zs. f. Physik* I suggested an interpretation of those regularities based mainly on the theory of band complexes and the analogy with the helium band spectrum. The analogy was incomplete in so far as the bands found in the spectrum of the hydrogen molecules are analogous to helium bands which can be predicted from theoretical considerations, but which had not been actually found. I have found these missing helium bands now. Their structure is exactly analogous to that of the hydrogen bands given by Richardson and Davidson (*Proc. Roy. Soc*, A, **123**, 54, 466, A, **124**, 50, 69), as will be best apparent from a description of their peculiarities. From the red to the violet we have the following branches .

Transition	Description of the Bands	Richardson's	Finkelburg and Mecke.
$\sigma\Sigma \longrightarrow 2\pi\Sigma$	P- and R-branch of about equal intensity	$^1K \longrightarrow 2^1S$	$^3D \longrightarrow 2^3S$
$\delta\Sigma \longrightarrow 2\pi\Sigma$	R-strong, P-weak	$^1C \longrightarrow 2^1S$	$^3P_2 \longrightarrow 2^3S$
$\delta\Pi_b \longrightarrow 2\pi\Sigma$	Only strong Q.	$^1B \longrightarrow 2^1S$	$^3P_1 \longrightarrow 2^3S$
$\delta\Pi_a \longrightarrow 2\pi\Sigma$	P strong, R weak	$^1A \longrightarrow 2^1S$	$^3P_0 \longrightarrow 2^3S$

In addition to these seven branches there is one more P-, Q-, and R-branch arising from $\delta\Delta_{a,b} \longrightarrow 2\pi\Sigma$ transitions. These branches are very faint, and their intensities make it probable that they are only present if the regular precession of the orbital electronic moment of momentum around the nuclear axis is considerably perturbed. It is not yet quite certain to which hydrogen bands these three branches correspond. If one takes these facts together with the arguments mentioned in the note in the *Zs f. Phys.*, the evidence in favour of the proposed explanation of the hydrogen bands becomes very strong The properties of the helium terms are well known (see the letter to NATURE of May 11 and a fuller discussion in print in *Zs. f. Phys.*), and therefore I think there is no reason to accept the conception of Finkelburg and Mecke (*Zs. f. Phys.*, **54**, p. 537) of the hydrogen bands which is given in the last column of the table.

All the bands the analysis of which seems most certain find their explanation in this way. The interpretation of some of the remaining terms does not seem to be easy. There are reasons, however, which make it not improbable that the assignment of initial vibrational and electronic quantum numbers ought to be changed for some bands. In such cases Richardson and Davidson's and Finkelburg and Mecke's analyses usually do not agree with each other

A few words may be added about the newly discovered helium bands. There are three groups of them, all belonging to the triplet system, one in the red (4σ and $4\delta \longrightarrow 2\pi\Sigma$), one near 535 $m\mu$, and one near 495 $m\mu$ (5σ and 5δ resp. 6σ and $6\delta \longrightarrow 2\pi\Sigma$). The group near 535 was first found by Merton and Pilley. It and the 495 group have been partly analysed by Fujioka (*Zs. f. Phys.*, **52**, p. 657). All the bands are degraded toward the violet. The initial terms were known from other bands, the new final term $2\pi\Sigma$ lies 6118·4 cm.$^{-1}$ *above* the corresponding $2\pi\Pi$- ($2p$-) term, whereas in hydrogen the $2\pi\Sigma$-level (B-level) lies 8892 cm^{-1} *below* the $2\pi\Pi$- (C-) level. This is the most remarkable difference between the hydrogen and the helium terms, whereas in most other respects they are exactly analogous. That will be seen more clearly from the detailed paper. The new helium bands will be described in collaboration with Messrs. Takamine and Imanishi. Their discovery also made possible the hitherto doubtful analysis of bands in the region around 400 $m\mu$ and 378 $m\mu$. It appears that perturbations of the kind described in my letter to NATURE of Mar. 23 occur for the $\sigma\Sigma$- (s-) and $\delta\Sigma$- (z-) terms. The perturbation moves to lower j if we go to the higher terms. $4z$ (17), $5z$ (9), and $6z$ (5) are the perturbed z-terms.

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The Primary Process in the Formation of the Latent Photographic Image.

I HAVE read with much interest the communication from Dr. F. C. Toy and Mr. G. B. Harrison in NATURE of May 4, 1929, p 679. The experiments described on the photo-conductance phenomenon in silver bromide afford valuable confirmation of the results obtained by Dr W. Vanselow and myself on the photo-voltaic effect at silver bromide : silver electrodes, which were briefly described in the sixth Hurter and Driffield Memorial Lecture.[1] These results, we consider, not only demonstrated the primary separation of electrons by light in the photolysis of silver bromide, but also gave the first evidence that this separation of electrons is actually related to the liberation of bromine. The negative potential difference ascribed to electron liberation is produced within $\frac{1}{500}$ second of the incidence of the light, attaining a maximum within $\frac{1}{25}$ to $\frac{1}{20}$ second.

We regard these, and other results now being published in the *Journal of Physical Chemistry*, as confirming the hypothesis of electron liberation from the bromide ion and transfer to the silver ion, which was proposed by Sheppard and Trivelli, and independently by Fajans, in 1921. Dr. Toy and Mr. Harrison interpret their recent results in terms of this same theory. Now it may be noted that the photo-conductance phenomenon by itself only shows the production of mobile electrons, but not that they are *valence* electrons from the bromide ions. The correspondence of the primary photo-conductance current with the photographic effect, as demonstrated for wave-length sensitivity and time-order sensitivity by Dr. Toy and his collaborators, is unquestionably very significant. Considered in relation with our measurements of the photo-voltaic effect, they strongly support the view that the inner photo-electric effects—photo-voltaic and photo-conductance—as also the photographic and photochemical effects, all derive from the same primary separation of the electron from the bromide ion.

In terming this the primary event, I take leave to differ somewhat from Dr. Toy and Mr. Harrison in regard to their statement on latent image formation.

[1] "The Formation of the Photographic Latent Image", *Phot. J*, **67**, 397-414, 1928

They say: "The complete building up of the latent image is now generally considered as divisible into two stages: (1) The absorption of light by silver bromide and the immediate resulting mechanism, and (2) complicated chemical reactions between the product of the light action and the other substances, such as gelatin, present in the emulsion." This description seems to me incomplete, because it applies equally to the formation of the visible image. It seems to me preferable to say that the primary event or elementary process is the separation of the electron from the bromide ion. We have then

$$\overset{-}{Br} + h\nu \longrightarrow Br + \theta$$

followed by other processes

$$\overset{+}{Ag} + \theta \longrightarrow Ag(\text{atom})$$
$$Br + Br \longrightarrow Br_2$$
$$Br + \text{Acceptor} \longrightarrow (A)Br$$
$$Br_2 + \text{Acceptor} \longrightarrow (A')Br_2 \text{ or } (A')Br + HBr$$

The formation of a latent image involves both the segregation of bromine *and* the aggregation of the silver atoms produced. The mode of this 'aggregation' appears to me an essential aspect of the "complete building up of the latent image".

This formulation of the steps tacitly assumes that no work of predissociation or disgregation of the silver halide lattice is necessary at the interface with a conductor, as suggested in my letter in NATURE (**121**, 574; 1928) and discussed in detail in the *Journal of Physical Chemistry* (**33**, 250; 1929).

S. E. SHEPPARD.

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The Classification of Soils for Purposes of Survey.

THE growth of interest in soil surveys of recent years and the impetus given to the natural study of soil by the work of the Russian pedologists have led to considerable discussion directed towards the formulation of a world system of classification. C. F. Marbut (*Proc. Intern. Congr. Soil Sci.*, iv. 1; 1928) has proposed a scheme which amplifies the earlier classification of Glinka, using profile as affected by climate as a basis. The problem of the worker in a small area will generally be the final subdivision of an area of soils mainly belonging to a single group in the world scheme.

The accompanying scheme indicates an attempt to classify Welsh soils, which belong to the feebly podsolised group, for the purpose of soil survey. The first division is into suites each characterised by the same or similar parent material and is, in a qualified sense, geological. The next division is into phases according to conditions of formation. This furnishes the series which, following American practice, are named after the localities in which they have been studied. The final types are given by considerations of texture.

For example, soils derived from non-calcareous sediments of Cambrian, Ordovician, and Silurian age, excepting hard crystalline grits, form one suite. Normal sedentary soils of this suite are called the Powys series and give such types as the Powys silt loam, Powys light loam, etc. The corresponding drift soils form the Penrhyn series, soil with impeded drainage, the Bethel series; podsolised soils, the Hiraethog series; and alluvial soils, the Conway series.

In addition there are a few series depending on purely local conditions of surface geology, and topographical soils, such as marine alluvium, dune, fen peat, mountain peat, and heath peat, for which it is proposed to use a descriptive rather than a local nomenclature.

G. W. ROBINSON.

University College of North Wales,
Bangor, June 5.

Parent Material	Free Drainage			Impeded Drainage	Alluvium
	Normal Phase	Drift Phase	Podsol Phase		
Igneous rocks, Pyroclastic rocks, Cambrian and Ordovician grits	Bangor	Ebenezer	Ogwen	?	?
Mona Complex	Anglesey	Gaerwen	Holyhead	Gesail	Braint
Palæozoic sediments, except Cambrian Grits	Powys	Penrhyn	Hiraethog	Bethel	Conway
Old Red Sandstone	Monmouth	?	?	?	?
Carboniferous Limestone	Gower	Pentraeth	?	?	Talwrn
Non-calcareous Carboniferous sediments	Neath	Merton	Ruabon	?	?
Trias	Salop	Wrexham	?	?	?
Rhætic and Lower Lias	Glamorgan	?	?	?	?

The Origin of Adaptations.

IN NATURE of June 1 there is printed the report of a lecture by my old friend, Dr. E. J. Allen, on "The Origin of Adaptations". I do not desire to enter into a detailed criticism of the views put forward in that lecture, but in one paragraph Dr. Allen refers to my views. He correctly states that I believe that definite proof of the inheritance of acquired characters is available in the works of Kammerer, Durkhen, and Brecher, but that Graham Kerr and Goodrich have put forward strong arguments on the other side. So far as I understand the attitude of Graham Kerr and Goodrich, it amounts to this: that having convinced themselves on *a priori* grounds that the inheritance of acquired characters is impossible, they refuse to credit any evidence on the other side. Such an attitude is very illuminating as to the mental outlook of these two biologists, but it is not helpful in throwing any light on the question.

The question of the reliability of Kammerer's results has been placed in an entirely new light by the visit of Prof. Przibram, who was Kammerer's teacher, to London. Przibram saw Kammerer's experiments performed, and in particular saw the critical specimen of *Alytes* living: the sole question for him was who, during Kammerer's absence on war service, interfered with this and other specimens. He had no doubt whatever as to the *bona fide* of the experiments, for they were performed under his immediate supervision.

As to Durkhen's work on the colours of the pupæ

of white butterflies, Przibram agreed with me that the experiment and the results obtained were a repetition and confirmation of Kammerer's work on *Salamandra maculosa* I think that I was the first in Great Britain to direct attention to the critical and important character of Durkhen's work, and I suggested to my friend Dr. Heslop Harrison, who had so much skill in breeding insects, that he should endèavour to repeat the experiment This he successfully accomplished, and this feat makes the dogmatic criticism of Kammerer's work look rather foolish.

Since that time Metalnikoff, of the Pasteur Institute in Paris, has proved the inheritability of acquired immunity in the caterpillars of the beeswax moth, and this experiment is doubly interesting, because the effect on the offspring of the acquired character only became obvious after five generations, incidentally confirming Lamarck's view, who rightly emphasised the importance of the time-factor in use-inheritance

Dr Allen quotes with approval Hertwig's statement that the real question is not "Are modifications inherited ?" but "How are new factors acquired ?" In this statement there lurks an obvious fallacy, which one might expect from Hertwig, but not from Dr. Allen There are no 'new factors' in animals Every apparently new factor turns out on close analysis to be an enhancement or a diminution of a pre-existing one, and the supposed difficulty of explaining the value and function of incipient characters can only be characterised as a Darwinian nightmare

E W. MACBRIDE

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Cosmic Radiations and Evolution.

THERE seem to be no sure grounds for believing that the penetrating radiations are uniformly distributed throughout space. If they are not, and if considerable variations in the strength of those reaching the earth have occurred in the past—possibly referable to translatory movements of the solar system—then serious effects upon organic evolution may have taken place. Millikan estimates their present energy as equal to about one-tenth of that reaching the earth from the luminous radiation of the stars At present, therefore, the penetrating rays are probably without positive effects upon organic life It does not follow, however, that a recent decline in strength would be without serious effects.

The influence of gamma radiations upon organic structures has been studied from many points of view. It would seem to resolve itself finally into one of ionisation, the gamma radiations when absorbed being transmuted into beta rays. Medical researches directed to the elucidation of the changes consequent upon radiations applied to healthy and to morbid tissues appear to lead to the conclusion that a selective influence is involved, the morbid tissues being destroyed by the same radiations as fail to affect the neighbouring healthy tissues, but which seem, rather, to stimulate the latter to an attitude of increased stability.

This at once suggests an issue of rather sensational kind, and certainly at present purely speculative. I refer to the present world-wide increase of cancer in its various forms This increase might be explained as due to the disappearance in recent times of a controlling factor which, in a word, acted in the same manner as γ-rays or X-rays upon animal tissues

J. JOLY.

Trinity College, Dublin,
May 26.

DR. JOLY has pointed out the possibility that cosmic radiations, acting as a purely environmental factor, have produced changes in the resistance of human cells to the attacks of cancer

In this connexion the work of Goodspeed and Olson (*National Acad. of Sciences*, vol. 14, No 1, Jan 1928) is of particular interest These investigators have shown that a high percentage of variation in the progeny may be produced by the radiation of the sexual cells of the parents with X-rays In one population of 200 plants from radiated parents there were more than 70 per cent of variant individuals. Visible alterations in the chromosomes accompanied these morphological variations The results were obtained with rather intense radiation acting for a short time

From these observations it appears possible that cosmic radiations (which are of the nature of X-rays) have been a factor in the production of variations by direct action on the germplasm.

HENRY H. DIXON.

School of Botany,
Trinity College, Dublin, June 10.

Electrified Omnibuses.

IT may be worth while to record in NATURE an observation made by me of electrification of an omnibus. Recently I was going to board an omnibus in Victoria Street and in order to do so grabbed the brass rail just as the omnibus was about to stop. In doing so I received an unmistakable electric discharge. On coming back after a short time I went to the same spot—opposite to the Army and Navy Stores—and put my knuckle against the rails of those omnibuses which I could touch before anyone else did so. In all cases in which they came along at a brisk pace and pulled up quickly I received a sharp prick from the spark. In one case a second application was rewarded by a second spark. It was at a time when the sun was shining down the street and all was as hot and dry as could well be. No doubt it was the scuffling of the rubber tires on the polished asphalt that gave rise to the electrification. In intensity the shock, if such a term can be used, was two or three times as strong as that obtained after stroking a cat by the fire on a frosty night, when a visible spark may be obtained from the cat's nose.

In all my experience of omnibuses this is the first time I have noticed this electrified condition, and I have never heard of it from anyone else.

C. V. BOYS.

66 Victoria Street, S.W 1, June 11.

Spectrum of Trebly Ionised Bromine.

I REPORTED classification of the spectrum of doubly ionised bromine in a previous note to NATURE of Feb 16, p. 244 Following that work, I have been able to classify the lines of trebly ionised bromine The chief lines of the group $N_2(O_1 \leftarrow O_2)$ have been thus located $^3P_2\,^3D_3$ line at $\nu = 36675\ 2$; the $^3P_2\,^3P_2$ at $\nu = 40130\ 8$, and $^3P_2\,^3S_1$ line at $\nu = 42247$. The singlet system and inter-combinations have also been obtained, namely, $^1P_1\,^1P_1$ at $\nu = 42177$. The differences are $^3P_0 - {}^3P_1 = 506$, $^3P_2 - {}^1P_1 = 933$, and $^3P_0 - {}^1P_1 = 2532$

SURESH CHANDRA DEB.

Physical Laboratory,
Allahabad, May 9.

The Origin of Variations.

By Sir OLIVER LODGE, F.R.S.

ARTICLES in NATURE have the advantage that they are addressed not merely to experts in the same line of work as their writer—these have to be placated rather than informed—nor are they specially addressed to the school-educated general public, who are more likely to recognise the etymological character of the terms used than to appreciate their physical or biological significance. Articles in these pages are, I suppose, primarily intended to reach workers in other branches of science, thereby putting them into touch with modes of thought differing from but akin to their own. Our relations with each other are somewhat like those of politicians in alien countries: the problems are different, the methods dissimilar, but the general aims are alike.

International exchange of views is sometimes valuable; international conversation at Geneva has become possible: and long may it be before NATURE is subdivided into delimited areas labelled A and B. Seldom, however, does a member of one group feel entitled to intervene or say a word concerning the business of any other group. If he does, he runs the risk of being regarded as a trespasser and treated with contumely. That of itself would matter little. What usually deters him is the doubt whether anything he has to say is likely to be of the smallest use: he might be merely airing his own ignorance. Well aware of that likelihood, he may nevertheless occasionally venture to intervene, with all due diffidence and dependence on the charity and better understanding of those whose knowledge is so thorough that they can afford to pardon crudenesses of expression, and be willing to give favourable interpretation to presentations from another point of view.

These remarks are introductory to some comments on this year's Joseph Hooker Lecture before the Linnean Society, by Dr. E. J. Allen, on "The Origin of Adaptations", as partially reported in NATURE for June 1, page 841; and without further apology I would thank him for this concise summary of opinions on so interesting a subject—first explicitly treated, so far as I know, by Bateson many years ago.

Take then the question of heredity, on which so much turns. Certain truisms may safely be laid down. The only material transmitted to descendants is the germ-plasm (using that term comprehensively as including germ and sperm). No portion of the soma is transmitted, and therefore changes in the soma can only be inherited if they are such as to modify the germ-plasm. We know, however, that that substance is modifiable by slight changes in the environment, and hence it would appear quite possible for body changes to have their due effect. Such change may be imperceptible; except when tested by the actuality of inheritance, they might otherwise escape observation: hence only experience can tell us what is heritable. The body is the organ which gains experience of surrounding conditions and adapts itself to them; whether it can transmit any part of such adaptation to the germ-plasm can only be effectively tested by observation of the descendants. If no such transmission occurs it is difficult to see how racial experience can contribute to progress. I gather that observation shows that evolution proceeds in such a way that descendants are on the whole better adapted to their surroundings than their ancestors; and further, that improvements do not proceed as if executed in accordance with some preconceived set plan, but that they are flexible and able gradually to follow unexpected changes in the environment which could not have been foreseen. Inheritance of modifications may be slow, but changes or adaptations of an individual may be quick, as when a flat fish rapidly and surprisingly adapts its coloration to suit the background on which it is placed. In other words, adaptability of a somatic kind exists in the individual as a fact of observation, so that there is no question about the possibility of individuals adapting themselves to circumstances. The question is how more serious adaptation, to permanently changed surroundings, can be conveyed to descendants.

The first *vera causa* suggested is natural selection and survival value. Permanent modification may result from the improved chances of life for those individuals who happen to be born with some approach to the favourable variation or mutation; subject to the added proviso that such innate peculiarity is transmissible by inheritance. This doctrine, though apparently true so far as it goes, obviously does not explain how the variation arises: it only acts as a lock to secure its continuance in the race when it has arrived. The problem of the origin of the variation is deeper than that. The survival of the fittest or the elimination of the unfit, alone, is little more than a shipwreck experience.

I will now make a quotation or two from the article referred to; and as it is so accessible, and this is not a controversial epistle, I will not hesitate to introduce into my quotations words in square brackets that are not in the original. In the second column of page 843, I read:

> "That evolution proceeds according to laws of the same character as other [known] laws of Nature, is the common basis of all modern evolutionary theory, and was held perhaps more strongly by Darwin, Huxley, and Weismann than it is by some writers of to-day."

The word "known" which I have thus introduced is surely important, for if it be omitted I do not see how anyone could doubt the statement. Every event must happen in accordance with laws of Nature in the widest sense. But as to whether at any given period those laws are all known, or rather whether the laws known to a particular generation are sufficient as a basis from which to explain every recognised phenomenon, may very well be doubted. That, I presume, is the only point on which modern

writers can differ from what may be called the Huxley point of view—or, to make it impersonal, say, from the view that the fundamental knowledge of Nature already acquired by humanity is sufficient to account for all observed phenomena. Those phenomena have been added to since the middle of last century, and everyone who knows anything of Darwin and his great protagonist must realise how eagerly the newer experimental results would have been assimilated and utilised by them.

GUIDANCE AND CONTROL.

The question which still remains open, as worded by Dr. Allen, is "*how* the soma influences the factors in the germ cell". Well, that is one way of putting it, from the material point of view; and an interchange or circulation of hormones has been suggested as a material method. For paternal inheritance this particular method may possibly lack cogency, but doubtless some machinery will be found; one can scarcely expect to see changes produced in matter without *some* appropriate mechanism! But that alone does not solve the problem. There is about the process a suggestion of purpose, as if, like all other mechanism, it were constructed for a definite object, and designed so as to work in a particular way. A random circulation of hormones, or of anything else, could scarcely be trusted to effect the precise changes which, having originated in the soma and possessing survival value, ought to be transmitted to the germ-plasm so that they may be inherited. Hormones may, for all I know, constitute the material means of conveyance; but how do they exercise that function? And what initiates or controls their activity? So much is left unexplained even when the machinery is discovered.

Material mechanism is just what can be followed by those whose business it is to study the physical basis of life, but mechanism is never self-explanatory. The most automatic mechanism ever constructed must have mind behind it, not indeed in its contemporary working, but in its design and purpose; and if the result of mechanical working simulates the effect of purpose, it may be wise to keep our minds open to the possibility that after all there may have been some purpose, or so to speak intention, in the change that is being observed and in the adaptation of the means. The mechanism whereby a flat fish (to go back to that merely popular illustration) changes its pattern when greater concealment can be thus secured, has I believe been made out: certain pigment cells swell, while others contract. That the animal knows what it is doing is quite unlikely: the mechanism presumably works automatically. But surely biologists scarcely feel that they have got to the bottom of the problem when they merely point out the mechanism!

Some biologists apparently realise that a statement in terms of automatic working is not ultimately satisfying, and are said to have introduced "the idea of some psychic or psychoid influence, controlling and regulating the processes of metabolism and organic growth"; which idea is deprecated by Dr. Allen, in common I suppose with many others, as too like "the animisms of primitive man", too suggestive of conscious purpose, "such as we know only in ourselves, or by analogy assume in higher animals".

Purposive action and planning, however, do after all exist in the universe, and therefore may have to be taken into account in ways of which we at present have no suspicion. It is true that the higher animals who thus act for the future have "an elaborately differentiated nervous system"; but that is only part of the mechanism for the forming and carrying out of a purpose. A machine does not really explain the rationale of its own action; no machine is able to do that. The most elaborate machine is a mere executive.

Suppose we revert to an earlier position and ask, How do we know that germ-plasm may be influenced and modified or adapted to new and unexpected conditions? Doubtless we know it in several ways, but among others by the direct experiments mentioned by Dr. Allen in the second column of page 842, where we are told "that the germ-plasm itself can be acted on by physical and chemical forces in the environment in such a way that mutations are produced". For

> "Harrison has shown quite clearly that the germ-plasm can be changed by chemical substances contained in the food of an animal, or in more general terms that the germ-plasm can be altered by the environment".

Here, then, is a change which has been produced through proper physical and chemical means and has resulted in a mutation. But surely Dr. Heslop Harrison may be not impolitely called "a psychic or psychoid influence, controlling and regulating the processes of metabolism and organic growth", and H. J. Muller, by finding the correct dosage of X-rays for mutation production, seems to be another of those influences. An imaginary observer able to watch the processes, but from whom the operator was concealed, might feel impelled to infer him. But indeed we need not appeal only to recent advances. The long-established procedure of breeders, and even of gardeners, long ago showed that mental operations—put into effect by a nerve-muscle system—were able to guide and direct the ordinary forces of Nature so as to produce variations almost at will. The beneficent progress of discoveries in agriculture, from which ultimately we hope so much, is an outcome of this purposive activity of a "psychic or psychoid influence". Such an influence is therefore another *vera causa*, which may be more widely operative than at present we imagine.

CONCEALED INFLUENCES.

It will be said, however, it is quite unfair to bring in the operations of a highly organised product of evolution, and use that as an analogy for what occurs in connexion with low organisms without any trace of psychic or even nervous development. How is it possible for anyone who wishes to adhere closely to the laws of Nature to think of any other

influences than those displayed by the organisms themselves? How can we detect concealed influences? If we attend only to matter, and to those laws which have been already ascertained, I admit it may be impossible. But a physicist is not limited to the contemplation of matter. He regards the behaviour of matter chiefly as a sign or indication of what is going on in space. Faraday showed that the phenomenon of electric charge would never be properly understood by attending to matter alone: he traced the electric field to a property of space. Charged conductors are only the boundaries or terminals of an electric field existing *in vacuo*. Similarly Poynting showed that an electric current is not propelled by anything occurring in a metallic conductor, but by an influence reaching the conductor through space. The energy of the sun reaches the earth in that sort of way. Atoms act on each other across intervening space; and it is to space that modern physics turn for explanation of cohesion, elasticity, and of what used to be called 'gravitational attraction.'

In fact, it may be said that modern physics attends very much to space and its properties, and utilises matter mainly as an index, demonstration, or manifestation of those properties. The very electrons of which matter is composed are spatial peculiarities, and seem to have more affinity with waves than our scientific ancestors suspected. An electric current, considered materially, is a procession of electrons; but the driving power is not an end-thrust like that of water through a pipe: the propulsion is a lateral propulsion exerted by electromotive forces which reach the conductor through the surrounding medium, along paths which can be mapped out.

Undoubtedly we are dependent on matter for every observation; we cannot study even ether or radiation without it; occurrences in space are concealed from us, they have to be inferred. For example, a magnetic field is an etheric or space phenomenon, and yet, admittedly, it is by aid of the properties of matter that we explore and investigate such a field. But matter after all is secondary; it displays and locates the phenomenon: it helps us to deal with it and make experiments upon it; yet an actual magnetic field is turning out more like a circulation in space than anything else. Before the discovery of electric currents, the only magnets known were natural magnets and those which had been propagated from them by regulated movements. One magnet could produce any number of others, without being itself weakened, and there was no magnetism without antecedent magnetism. The parable is obvious.

The progress of science in that department, however, led on to the production of artificial magnets, electromagnets, whereby fresh magnetism could be generated by setting electricity in motion. Yet, even so, 'generated' is scarcely the correct term. The act of magnetisation seems to be only the utilisation and opening out of circuital relations which already exist, so that instead of being shut up into infinitesimal configurations they are displayed openly and made manifest. Pre-existing but imperceptible magnetism could be incarnate in matter and exhibited. All matter has close relations with the space surrounding it. Radiation is a constant means of communication, not only obviously, but also secretly, in ways only recently discovered. An atom under certain conditions can emit energy into space, and can receive energy from space; and all material activity is the result of this interchange of energy. In space, the energy is what we call potential; in matter, it is what we call kinetic. The one form is continually passing into the other, and back again.

It must be admitted that analogies prove nothing, but they are sometimes suggestive. My suggestion is that life is something which primarily exists in space, though we only know of it when it is associated with and displayed by matter. I venture to say that we shall never understand life so long as we attend to its material manifestation alone. We must always use matter as our index and means of exploration, because it is matter alone that appeals to our senses; but the reality may lie beyond or behind matter, and may only interact with it for a time. We should never have understood the laws of an electromagnetic field, and the nature of radiation, by theorising as if matter were supreme. Even now we scarcely understand the nature of gravitation, though we can apply its laws with considerable success to the motions of material bodies. Similarly, the nature of life is unknown, though a vast amount has been learnt about living bodies.

I would ask biologists to consider whether they could not, as a working hypothesis, begin to contemplate life as something existing in space as in a sort of infinite reservoir, out of which it could under appropriate stimulus enter into association with molecules of sufficient complexity to enable it to catch hold and become as it were incarnate. They might go on to suspect or infer concealed mechanism, not of a perceptible material kind, but still possibly of a physical nature, activated by something at present unknown. I suggest that concealed powers have put the organism together, in a specific form, out of such materials as came to hand. When the machine goes out of order the controlling powers cease to be able to display themselves: the instrument of manifestation is spoilt. But we need not jump to the conclusion that when they related themselves to matter they came into existence, and that when they leave matter they cease to be.

Few of the controlling powers can have attained an individual or personal existence, but we know that matter, in its more complex and higher protoplasmic forms, has been the means of individualising those concealed activities; and consequently, as developed personalities, we ourselves are able to testify and help the explorers. If they made use of all the information available they would have a wider scope for contemplating the apparently purposive movements of live things, and might realise that in studying as they do the material basis of life, they are studying the influence of some

controlling entity—perhaps etheric, perhaps psychic, probably both—by aid of the material mechanism which it utilises

CONDITIONS FOR VITALITY.

There are certain narrow conditions which have to be satisfied before live things can appear—a certain narrow range of temperature, the presence of chains of carbon atoms and perhaps of oxygen and liquid water—all of which are commonly called the conditions necessary for life to exist I would rather call these the conditions necessary for vitalising or animating matter—the conditions for vitality, in other words, the conditions enabling life to enter into association with matter. I admit that it is the peculiar behaviour of organised cells that we commonly designate by the term 'alive', but we must not be too much hampered by our use of terms Animated matter displays life, and the display or manifestation of life we might call vitality When vitality ceases we are apt to imagine that life has gone out of existence But we do not think that electricity has gone out of existence when a body is discharged, though it is no longer electrified, nor need we think of magnetism as going out of existence it can become concealed and go out of our ken Nor do we think of electricity as ever coming into existence—at least not under observation, it can be localised so as to display itself by material effects Animated matter behaves in a curious way, and so does electrified or magnetised matter. A compass-needle points north and south, as if mysteriously cognisant of those regions. but everyone knows that it is only acted on by the peculiarities of the space near it

Similarly, if we try to understand apparently purposive action in animated matter, we may fail unless we realise more clearly that something is controlling and being itself displayed by that matter. An electrician uses a compass-needle or a filament to display or manifest an electric current, but he would not understand much about the current if he limited himself to a discussion of its material manifestation Nor do I think that we shall understand much about heredity, and the other strange occurrences dealt with by the biologist, so long as we attend only to the material vehicle or instrument of life Life enters into a nascent organism gradually, as its cellular constitution is enabled to receive it, and when, in the long course of evolution, an organism has attained sufficient complexity, the higher stages or aspects of life, called mind and consciousness, enter or are manifested too But a study of the mechanism alone will never detect more than an indication of our thoughts, plans, hopes, and aspirations, nor can we thus explain consciousness and our power of understanding what is going on in the material explored

One more quotation from Dr Allen in conclusion, with which, I need scarcely say, I heartily agree, especially if extended by the words in square brackets

"In whatever direction we look problems bristle, problems open to successful attack, and the old qualities, insight, patience, and determination, will get them solved But we must not limit the outlook, and all aspects of biological research must proceed hand in hand Botany, zoology, palæontology, the work of the systematist and of the field naturalist, the study of structure and the study of function, the work of the embryologist and of the experimental physiologist, of the geneticist and of the statistician [aye even of the physicist and the psychologist], all are necessary, and none can succeed without the others"

The Joint Meeting of the French and British Associations at Havre.

IN 1914, while the British Association was meeting in Australia, the delegates of the Corresponding Societies were invited as guests at the conference of L'Association Française pour l'Avancement des Sciences, then being held at Havre. Those who were present will remember the hospitable way in which they were entertained at the Hotel Frascati, at the meetings and excursions. though as day by day passed there seemed to be something mysterious going on; the hotel gradually emptied, there were signs and whisperings, the members were impressed by the enormous accumulation of food-stuffs in the warehouses, and before the meeting was closed the declaration of war explained a good deal. The members had to find their way back to England as best they could, and those who had the experience will never forget it.

The French Association, towards the end of July this year, again meets at Havre, and as the principal members of the British Association will then be at South Africa, our French colleagues have again extended the courtesy of inviting the other members of the British Association to attend its conference at Havre without any extra fee beyond the ordinary subscription to the British Association, which would be paid in any case

In addition, the French Association has invited the delegates of the Corresponding Societies to hold their conference during the Havre meeting, and in connexion with this a sub-committee was appointed consisting of the president of the Conference of Delegates, Dr. F. A Bather; the secretary, Dr C. Tierney; and the acting secretary for the Havre meeting, Mr T Sheppard. Sir Henry G. Lyons was also appointed the official representative of the British Association and chairman of the organising committee referred to.

At the Glasgow meeting of the British Association, Dr A. Loir, whose courtesy was so much appreciated in 1914, was present and gave an official invitation to the General Committee of the British Association and was prepared to do the same for the Conference of Delegates, but apparently that body was too fully occupied to spare the necessary time Mr T Sheppard has recently visited Havre and met the chairman of the Local Committee (the English Consul, Mr. H C Swan), Dr. Loir, and others interested in the local arrange-

ments. The Hôtel des Sociétés Savantes, next to the Lycée de Garçons, where the meetings of the French Association will be held, has been generously placed at the disposal of the British Association for any special meetings, etc. These rooms provide a general meeting room for the delegates, a committee room, and an exhibition room During the conference, Dr. Bather will give an address on museum matters to a section of the French Association, and Dr. Pullein will speak on radiology at the request of the Association. The Conference of Delegates will be held at 5 P M. on July 26, when the question of the Channel Tunnel from both engineering and geological points of view will be discussed The British committee is arranging an exhibition of air photographs, regional survey maps, etc.

The French Association commences its programme on Thursday, July 25, at 11 A M., when the opening session will be held at the Grand Theatre. In the afternoon is the organisation of the sections, and in the evening a reception by the Corporation at the Town Hall On Friday, July 26, there will be papers and discussions ; visit to exhibitions organised at the Lycée de Garçons, natural sciences by the Geological Society of Normandy and the Linnean Society of the Seine Maritime, and exhibits by the civil engineering, dentistry, meteorological sections, etc , visit to the Port and a liner ; and a conference at the Grand Theatre. On Saturday, July 27, there will be a visit to the English exhibitions and museum ; visit to the museum at Old Honfleur, and a public conference in the Franklin Hall Sunday, July 28, will be occupied by a general excursion to Fécamp , and the unveiling of a monument to Dr. Léon Dufour. On Monday, July 29, further discussions, visits to various buildings, and in the afternoon an excursion to the Art Gallery and New Archæological Museum at Graville Abbey. In the evening there will be a soiree at the Municipal Casino or on a liner. Tuesday will be occupied by papers and discussions and the closing session. On Wednesday, July 31, and Thursday and Friday, Aug. 1 and 2, there will be final excursions to Grouville, Lisieux, Caen, Bayeux, Mont St Michel; and Rouen and district.

Inquiries in reference to the meeting should be addressed to Mr. T. Sheppard, at the Museum, Hull, or to Dr. A. Loir, Comité Local, Hôtel de Ville, Le Havre, France.

News and Views.

ON June 26 the centenary occurred of the death of James Lewis Smithson, who by his will, dated Oct. 23, 1826, left his fortune " to the United States of America to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men." Born in France in 1765, Smithson was the illegitimate son of Hugh Smithson (1715–86), who married the heiress of the Percy property, took the name of Percy, and in 1766 was made Duke of Northumberland, and of Mrs. Elizabeth Macie, widow of James Macie, of Bath. He was known during the first half of his life as James Lewis Macie, and under that name he entered Pembroke College, Oxford, graduated as M.A. in 1786, and was the following year admitted a fellow of the Royal Society. His attainments in chemistry and mineralogy were vouched for by Kirwan, Blagden, and Cavendish, and Smithson's life was mainly devoted to scientific studies. He travelled and lived much abroad, counted among his friends and correspondents, Davy, Thomson, Cavendish, Biot, and Arago ; contributed some 27 papers to the *Philosophical Transactions*, Thomson's *Annals of Philosophy*, etc , and collected a great mass of notes on various subjects. His death took place at Genoa, and his grave, until the end of 1903, was to be seen in the little English Cemetery on the heights of San Benigno overlooking the Gulf of Genoa. Early in 1904 his remains were exhumed and, under the supervision of Alexander Graham Bell, conveyed to Washington, where they now lie in a mortuary chapel in the great institution founded through his action

SMITHSON'S fortune came to him through his mother, who could claim descent from Henry VII. and was connected with the Hungerford family of Studley. In his will he directed that his property should first go to a nephew, Henry Hungerford, and it was in the case of his nephew's death that it was to go to the United States. It was not until 1837 that any of the money was received in America, and a further nine years elapsed before Congress decided to accept the trust and found the Institution. The Board of Regents designated by the Government met on Sept 7, 1846, and one of their first acts was to appoint Prof. Joseph Henry, of Princeton, as secretary. It is not too much to say that it was largely owing to Henry's foresight, energy, and broad-mindedness that the Smithsonian Institution soon gained an international reputation. Henry has been succeeded by Spencer Fullerton Baird (1878–87), Samuel Pierpont Langley (1887–1906), Charles Doolittle Walcott (1907–1927), and the present secretary, Dr. Charles Greeley Abbot. " Smithson's wishes ", wrote Langley thirty years ago, "have been carried out by those immediately administering them with a constant scrupulous thought of the intent of the founder, while in doing this the best results have flowed from a rigid construction of his own words, so briefly expressed, and from a division of the activities of the Institution into two great distinct but parallel paths, the ' increase ' and ' diffusion ' of knowledge ". The motives which led Smithson to leave his money to the United States will probably remain unknown, but we are in no doubt as to the admirable manner in which his wishes have been carried out or of the fruitfulness of his bequest.

IN his presidential address to the Pharmaceutical Conference in Dublin on June 25, Mr. R. R. Bennett dealt with some aspects of materia medica in which a rational use of drugs has replaced a crude em-

piricism, owing to recent advances in chemistry and physiology and in the science and practice of medicine. Such increased knowledge has led to improvement in the public health, and to the discovery of new remedies, the beneficent effects of which are world-wide in their application. In the tropics especially, knowledge of the natural history of parasitic diseases and the discovery of drugs exerting a curative effect have led to a measure of control which makes available for human habitation large tracks of otherwise unhealthy country In this work the part played by synthetic drugs is of great importance, but in spite of the discovery and use of powerful new remedies our knowledge of the relationship between chemical structure and physiological action is fragmentary. It can only be increased by the systematic preparation of new compounds and the examination of their pharmacological properties. In this connexion the establishment of a chemical research laboratory at Teddington under the general scheme of research directed by the Department of Scientific and Industrial Research must be regarded as an experiment of great interest In collaboration with the Medical Research Council, an endeavour is to be made to obtain experimental evidence of the relationship between constitution and activity.

NEW remedies or methods of treatment are often of respectable antiquity. Mr. Bennett mentioned that ephedrine, which has found a place in the treatment of asthma, is similar both chemically and pharmacologically to adrenaline : it was isolated, but not used, fifty years ago : the Chinese, however, have employed the crude drug for more than two thousand years. Again, animal preparations were used as medicinal agents, only to fall into disfavour: now they are coming into vogue again, and some exert a specific effect in certain diseases, for example, liver and its extract in the treatment of pernicious anæmia, or thyroid gland and its active principle, thyroxin, in the treatment of cretinism. The tendency is to replace the crude drug with the active principle extracted from it ; then the latter is prepared synthetically, often more cheaply than the natural product, and except for the fact that the synthetic compound requires resolution into the optically active isomers, it is identical with that prepared in Nature's laboratories But modern remedies include more than is implied under the term drug : organotherapy is assuming as important a place as chemotherapy, vitamins can be prepared in concentrated form, and, finally, bacterial products play an indispensable part in the treatment of many diseases Vaccination for smallpox, antitoxins for diphtheria or tetanus, and still more recently inoculation for canine distemper and yellow fever indicate the wide range covered by the modern use of the term remedy. Finally, it must not be forgotten that physical methods also play their part, of which the use of radium in cancer may be considered a most notable example.

THOUGH the loss of life was fortunately small, the earthquake that occurred in New Zealand on June 17 appears to have been the strongest felt in that country since 1855 The epicentre lay in the north-west of the South Island, the greatest damage having been done at Westport, Greymouth, and Murchison. At these places scarcely a building escaped serious injury. At Nelson a tower fell, so that the area of damage must have been more than 150 miles long in the south-south-west direction and about 50 or 60 miles in width. In the epicentral area, landslips were unusually frequent and large, and, indeed, most of the fifteen deaths reported seem to have been due to landslips rather than to the fall of buildings Our record of New Zealand earthquakes is a brief one, but, in the century that has elapsed since 1826, no other prominent movement appears to have occurred in the centre recently in action The three great earthquakes of Oct. 16, 17, and 19, 1848, visited a district fifty miles or more to the east, in the chain of mountains that runs south-south-west from Cloudy Bay, along which a remarkable fissure 60 miles long was then formed. The still greater earthquake of Jan 23, 1855, occurred in the south-east end of the North Island, its epicentral area being in or near the continuation of that of the earthquake of 1848 With this earthquake, an area of 4600 square miles was raised from one to nine feet, the greatest elevation being along the line of the Wairarapa Valley

AMONG the recent additions to the British Museum (Natural History) are the late Dr. J de Bedriaga's herpetological collections and a selection of books and pamphlets from his library, presented to the Department of Zoology by Dr. G. A. Boulenger This collection (1306 specimens) is especially rich in representatives of the numerous races of the wall lizard from the islands of the western Mediterranean. The books and pamphlets, 159 in number, are almost all works or editions new to the zoological library of the Museum. Dr Hugh Scott and Mr. J. Omer Cooper have presented to the Department of Entomology some 40,000 insects collected in Abyssinia during their expedition to that country in 1926–27. The entomology of the high plateaux of Central Abyssinia, where these collections were made, has been relatively very little investigated, but is of great interest owing to the peculiar mingling of tropical African, northern, and Oriental forms. Certain small groups already worked out show a high percentage of species new to science.

THE collection of Lepidoptera made by the late Mr. A. E. Wileman during his thirty years' consular service in Japan, Formosa, and the Philippine Islands, which consists mainly of moths and comprises some 25,000 specimens, including nearly 760 types, has been presented to the British Museum (Natural History) by Mrs. Wileman in memory of her husband. Dr J. M. Aldrich, of the United States National Museum, Washington, has presented a series of dried larvæ of a Saturniid moth, *Coloradia pandora*, Blake, from the Mono Lake district, California. The caterpillars of this moth feed on the needles of a species of pine (*Pinus jeffreyi*) at an altitude of some 7000 feet, and are collected, dried, and used as food by the local Indians. The life-cycle of the insect occupied

two years, and, as an indication of the numbers in which the caterpillars sometimes occur, an Indian chief is said to have prepared a ton and a half of these larvæ during a single summer The Department of Mineralogy has received from Mr F. N. Ashcroft a further selection of about a thousand mineral specimens, representing more than a hundred Swiss localities With Mr. Ashcroft's previous donations of Swiss minerals and those bequeathed by the Rev J. M. Gordon in 1922, the Museum now possesses the finest collection extant for illustrating the conditions of mineral growths in the special type of Alpine veins.

SIR RICHARD GREGORY's presidential address to the Royal Meteorological Society last January, entitled "Amateurs as Pioneers", which has just been published (*Quar Jour. Roy. Met Soc*, vol 55, No 230), deserves to survive as a chapter in the history of British science Nowhere in the world has the amateur flourished as he has in Great Britain, and he flourishes still It has often been pointed out that, though it is easy to beat the Englishman in the field of high specialism and technique, if the view be extended so as to take in the larger number of amateurs and fairly good performers in any branch of study or of sport, Great Britain may face the world. In this matter it is the same with tennis as with Greek, with chess as with meteorology. Sir Richard is concerned mainly with contributions to the last-named subject His contributors range from the Rev William Merle, or Morley, who went from Oxford to be rector of Driby in Lincolnshire in 1331 and kept a systematic record of the weather for seven years, down to the amateurs of the present day, who have set up two-way radio communication between England and the Antipodes on a wave-length of 80 metres.

METEOROLOGY has been a favourite field for the amateur In 1846, James Glaisher, following a long line of amateur observers, was able to correct a false conclusion published by the Registrar-General as to the relative temperature of London and York. As a result he was requested to collect suitable observations for inclusion in the "Quarterly Returns of Marriages, Births, and Deaths". He thereupon formed a band of 50 to 60 voluntary observers who became the nucleus of the Royal Meteorological Society and the pioneers of the Meteorological Office The exploration of the air has been the special triumph of the amateur The same Glaisher became famous as a balloonist, and some stirring pictures are published in this pamphlet of his experiences, ascending and insensible, at the height of seven miles. The Royal Society itself, indeed, and practically all the pioneers of the seventeenth century, were amateurs, at a time when the universities were close in the grip of religious controversy and Aristotelian dialectics It was men out of touch with this who first came together in Oxford, and afterwards consolidated their efforts in the Royal Society in London They were mostly men of means, and it would be well for us if as large a proportion of that class were amateurs of science to-day.

SINCE 1846 the only material changes in the scope of the United States National Museum have been the addition of a department of American history, and in 1920 the separation of the National Gallery of Art as a unit Now, as the Report for 1928 shows, there is imperative need for further accommodation for purposes both of exhibition and storage of study collections. Especially, it would appear, has natural science suffered, since exhibits of animals have been curtailed to make way for historical subjects, and space designed for anthropology has been pre-empted for objects of art. In view of this contraction of natural science in favour of other studies, we turn with interest to the records of visitors, which give an indication of the comparative interest taken by the people in the different groups of exhibits In the first complete year in which natural history is treated as a separate group, the number of visitors to this section was 151,112, while 'arts and industries' claimed 207,010. But now (1927–28) the numbers are respectively 618,773 and 517,238; and this scarcely gives the true contrast, for a glance shows that natural history must have claimed on an average during the last eighteen years about 200,000 additional visitors a year. Thus the public gives little excuse for extending art at the expense of natural history. A large part of the Report deals with the activities of each of the departments, in acquisition, research, exchange, and so on. The extent of the collections which have now been amassed may be judged by the fact that the department of geology possesses more than two million specimens, and biology well over eight million It is sad to read that of the 333,329 birds in the collection, 8126 have been classed as 'alcoholics'—and this in a dry land.

ON Jan. 5, 1927, the Governor-General of Canada in Council gave authority "to designate the Museum branch of the Department of Mines the 'National Museum of Canada.'" Thus the Museum publicly assumes a national relationship towards which its activities have been broadening since it began as a part of the Geological Survey of Canada in 1841. During that developmental period, many changes have taken place. Gradually the purely geological activities have had added to them anthropology, biology, and palæontology, each now claiming a division of its own At the same time, various transferences of site have moved the Museum, first from its original home in Montreal to Ottawa in 1880, and there, finally in 1910, to the handsome Victoria Memorial Museum, where the collections and staff have since been housed, except during a partial and temporary dispossession, from 1916 until 1920, when, their own Parliament House having been destroyed by fire, members and senators transferred their activities to the Museum building. An account of the history of the Museum and of the developments due to each of its successive directors, from Sir William E. Logan to the present day, has been written by the acting director, Mr. W. H. Collins, for the Annual Report for 1926, just published, the first of a series of reports proposed to be devoted wholly to the interests of the National Museum of Canada.

THE Council for Scientific and Industrial Research for the Commonwealth of Australia has issued its second annual report (Canberra H J Green, 1929. 1s 8d) The Council, being a new department, is still mainly occupied in building an efficient research institution to co-operate with existing institutions in solving many pressing national problems. Although some investigations have been initiated, the Council has principally taken over investigations that were in progress Four divisions, each under a chief, have already been formed They are animal nutrition, economic entomology, economic botany, and forest products A fifth division to deal with animal health is in course of formation So far the Council undertakes to carry out extensive investigations only in those fields where it has been found possible to find a suitable chief of the division. The report dwells on the lack of efficient research workers in Australia in the fields where work is most required, that is to say, in pastoral and agricultural problems A plea is made for the more extensive training of research workers in the biological sciences The difficulty is partly overcome at present by extensive co-operation with the Australian universities and the State departments of agriculture. The report contains notes on many valuable lines of research now under way

THE Australasian Antarctic Expedition (1911–1914) Scientific Reports, Series B, vol 2. (Terrestrial Magnetism and Related Observations), Part II, issued in March 1929, is devoted to a discussion of "Magnetic Disturbance and its Relations to Aurora", by the late Dr C Chree (Sydney. Alfred James Kent. 15s.) Of the 132 pages in this part of vol. 2, 53 are occupied by tables and 79 by text, it is to be regretted that no summary of the conclusions resulting from this long discussion is included Of the four chapters, one only is devoted to the connexion between auroræ and magnetic disturbance; when auroræ are specially intense, so also, in general, is magnetic disturbance, but on more ordinary occasions there appears to be no close relationship between the two phenomena, in the Antarctic. The other chapters deal with daily and hourly character figures for disturbance; the international daily character figures are found to be on the whole indicative of Antarctic as well as of non-polar conditions.

THE Department of Embryology in the Carnegie Institution of Washington has from the outset, under the late Prof Mall and now under Prof. G. L. Streeter, pursued a policy of close association with other departments engaged in related work in its own institute and in the Johns Hopkins University and Medical School, as well as with the general medical profession. The policy has been a fruitful one for the study of human development, for many of the researches summarised in *Year Book* No. 27 could only have been carried out upon material obtained from such outside contacts. The programme of study is of the widest character. More than forty investigations have been completed or were in progress during the year reviewed, to June 30, 1928. They included researches on the differentiation of primitive tissues from the mammalian egg, the origin of the human heart, the locomotion of white blood cells, organogenesis, and the functions of the corpus luteum and other ovarian structures A monkey colony recently established has yielded interesting results bearing upon the duration and symptoms of pregnancy and the act of parturition, while many studies have been devoted to the nervous system, particularly to the correlation between function and structure, and to the phenomena of growth in the higher primates and man.

VOLUME 19 of "Contributions from the Jefferson and Cruft Laboratories of Harvard University" contains reprints of 72 papers by the staff and research fellows which have appeared mainly in American scientific journals during the years 1926–27. Ten of these papers are by Prof. P W. Bridgman, who has continued his work on the properties of substances under high pressures. Prof. E. H. Hall contributes five, mainly on the emission of electrons from the surfaces of bodies, and Prof. Lyman four on ultra-violet spectra Prof Duane and Dr. R. J. Havighurst, a research fellow, are responsible for ten on crystal analysis by X-rays, and Prof R S. Mulliken and two research fellows for eight on the relations between band spectra and electronic structure of the emitting molecule Dr. J C. Slater contributes five and Dr E. E. Witmer, a research fellow, four on the structure of atoms and the bearings of wave mechanics on the subject Prof. G. W. Pierce describes his magnetic oscillators, giving frequencies from a few hundred to 300,000 per second. A rod of magnetisable material passes through the centres of two coils, one connected to the filament and plate, the other to the filament and grid of a valve with a condenser in the circuit. The oscillating currents produce changes of length of the rod, and the apparatus is much more convenient than the piezo-electric generator. The volume maintains the high standard its predecessors have led us to expect from Harvard.

WE have received a copy of the prospectus announcing the sixth great exhibition of chemical apparatus and machinery to be held at Frankfurt-on-Main on June 10–22, 1930. The brightly decorated cover shows the remarkable growth in size of successive exhibitions since the first of its kind was held at Hannover in 1920, and it is confidently expected that the Frankfurt exhibition will excel in importance even that held two years ago at Essen. Many foreign countries will be represented among the exhibitors, and members of the *Dechema* (*Deutsche Gesellschaft fur chemisches Apparatewesen*, Seelze, bei Hannover) will receive special privileges Frankfurt is described as the greatest centre of chemical industry in the world In addition to this, the manufacture of chemical machinery and apparatus has grown to very considerable importance in the neighbourhood The exhibition will be held in four large halls, which are housed in three main buildings, plans of which are given The main avenues in the exhibition bear the names of famous chemists—Liebig, Bunsen, Wohler, Emil Fischer, Nernst, Ostwald, Baeyer, Willstatter,

Goldschmidt, Raschig, and others. The first hall will contain scientific apparatus and instruments for laboratory use, technical measuring instruments, and also the postal department, press-rooms, and writing-rooms. In the second hall will be found porcelain and stoneware and products of the ceramic industry. Machinery and appliances used in the industry of oils and fats are to be assembled in Hall 3, a section of which will be devoted to the chemistry of daily life, whilst in the fourth hall large technical apparatus and machinery used in chemical industry, together with complete exhibitions of plant and processes and also raw and other materials, will be found.

The forty-first Congress and Health Exhibition of the Royal Sanitary Institute will be held at Margate, at the invitation of the Town Council, on June 21–28, 1930.

In Nature of May 25, p. 795, Messrs. C von Bonde and J. Marchand described a case of 'Siamese twins' in the spiny dogfish. We find that similar twin dogfish were caught by a trawler in the English Channel and landed at Newlyn on Aug. 25, 1928, and a reproduction of a photograph of the specimen was published in the *Fishing Gazette* of Dec. 22, 1928.

Referring to the note on p. 922 of Nature of June 15, on a course of electrostatic methods in biology in Basel, Mr. R. Keller points out that it is scarcely correct to state that he and his colleagues "are introducing physical methods into biochemistry". This has already been done by other workers. The Prague school is specialising on certain electrostatic *microscopical* methods.

In order to facilitate the work involved in preparing the annual publication of "Organic Syntheses", the editorial board has been fortunate in securing the co-operation of Dr. C. F. H. Allen, of Tufts College, Mass., who is acting as secretary to the board. All correspondence regarding "Organic Syntheses" may be addressed to Dr. Allen, who will receive contributions to be considered for publication in future volumes.

The Old Students' Association of Faraday House Electrical Engineering College has this year elected Dr. Alexander Russell as its president to commemorate the fortieth anniversary of his appointment on the staff of the College It was in 1882 that the Hammond Electrical Engineering College for training electrical engineers was founded, and it was in 1889 this was merged in the present Faraday House College Since then, some 2050 students have entered Faraday House, and of these more than 900 are members of the Old Students' Association A portrait in oils of Dr. Russell, by Miss A. M. Burton, has been presented to the Governors by the artist's brother, Mr. R G. Burton, who was at Faraday House during 1912–1915, and is now with the well-known firm of Messrs. A. Reyrolle and Co. A reproduction of the portrait forms the frontispiece of the summer issue of the *Faraday House Journal*

The drawbacks to most of the radio-receiving sets at present on the market are the difficulties connected with keeping them thoroughly clean and in good condition, the periodic charging of the low-pressure accumulators, and the replacing of the high-tension batteries. Those who use the electric light often wonder why electricians do not use the domestic electric supply and thus get rid of both accumulators and high-tension batteries. Good progress, however, has been made in this direction. When the domestic supply is alternating current, it is not difficult to buy quite satisfactory 'eliminators' which require neither batteries nor accumulators With direct current supply the practical problem of abolishing the high-tension batteries has been achieved and excellent progress is being made in the direction of abolishing the accumulators Messrs Claude Lyons, Limited, of 76 Old Hall Street, Liverpool, issue a catalogue called "Getting the most out of Radio". The ordinary scientific reader who wants to know the latest developments in methods of receiving broadcasting will find this catalogue very instructive. Much of the apparatus described has been made by the General Radio Company of America. The products of several English manufacturers are also described Excellent hints are given of the best methods of keeping sets in condition. As it is very difficult to get piezo-electric crystals large enough to give fundamental frequencies below 25 kilocycles, we are glad to see that magnetostriction oscillators can be purchased suitable for low frequencies The same firm also publishes a booklet describing a 'clarostat', an instrument which does for high resistance what a variable condenser does for capacitance It provides a method of continuously varying the value of a high resistance The material used is a highly pulverised graphite intermixed with pulverised mica. The resistance is altered by applying pressure. This material should also prove very useful in the laboratory.

Catalogue No. 169 of Messrs. Dulau & Co, Ltd., 32 Old Bond Street, W.1, just issued, gives particulars of 1200 second-hand works dealing with botany and horticulture. The prices asked appear to be reasonable.

We have received from M. Paul Lechevalier, 12 Rue de Tournon, Paris, a copy of that firm's catalogue No. 114 of second-hand works relating to zoology, nearly 1800 in number, published for the most part outside the British Isles.

We have received from Messrs. J. H. Steward, Ltd., 406 Strand, London, a copy of their new catalogue of surveying, drawing, and nautical instruments. The catalogue illustrates a wide choice of theodolites, levels, plane tables, compasses, aneroids, drawing instruments, etc. Full specifications of the instruments are given.

A Special Clearance List of instruments has just been issued by the City Sale and Exchange, Ltd., 81 Aldersgate Street, London, E.C.1. It is classified, and various sections deal with field glasses, telescopes, surveying apparatus, etc, with a miscellaneous group including microscope accessories, mathematical instruments, and a 3-inch Watson's Student telescope. Deferred payments can be arranged.

THE latest addition to the valuable series of catalogues of Messrs. Bernard Quaritch, Ltd., 11 Grafton Street, W 1, is No. 426, which deals with upwards of 1600 works classified under the headings of botany, agriculture, early medicine and surgery, forestry, fruit-culture, gardens and gardening, herbals, modern medicine, and tobacco. Many of the volumes offered for sale are rare.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned — A principal of the Birmingham Central Technical College—The Chief Education Officer, Education Office, Margaret Street, Birmingham (July 1) A temporary lecturer in physics at the Birmingham Central Technical College—The Principal, Central Technical College, Birmingham (July 1) An assistant in geography at the London School of Economics and Political Science—The Secretary, London School of Economics, Houghton Street, W.C.2 (July 1). A demonstrator in botany—The Secretary, King's College, Strand, W.C.2 (July 2). An assistant lecturer (woman) in the Department of Education—The Secretary, King's College, Strand, W.C.2 (July 2). A junior forestry inspector under the Department of Agriculture — The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (July 3). A resident lecturer (man) in geography and mathematics—The Principal, Normal College, Bangor (July 3). A chief instructor in the Engineering (Production) Department of the Wolverhampton and Staffordshire Technical College—Clerk to the Governors, Education Office, North Street, Wolverhampton (July 4). A research student in experimental physics —The Registrar, Trinity College, Dublin (July 5). A professor of geology at the University of Glasgow—The Secretary of the University Court, University, Glasgow. An assistant lecturer in biology, who will lecture in botany, and a part-time demonstrator in biology—The Warden and Secretary, London (Royal Free Hospital) School of Medicine for Women, 8 Hunter Street, W.C.1. A civilian education officer, Grade III., at the Royal Air Force Electrical and Wireless School —The Secretary, Air Ministry, Gwydyr House, Whitehall, S.W.1. A full-time lecturer in modern languages (French and German) at the Royal Technical College, Salford—Secretary for Education, Education Office, Chapel Street, Salford. A principal of the Kenrick Technical College—Director of Education, Education Offices, Highfields, West Bromwich. A lecturer in biology and mathematics at the Bishop Otter College — The Principal, Bishop Otter College, Chichester. An assistant with experience of biological and physical apparatus, for sales department — Messrs. Griffin and Tatlock, Ltd., Kemble Street, W.C.2.

Our Astronomical Column.

THE DISINTEGRATION OF COMETS —Mr. N. T. Bobrovnikoff contributes an important study on this subject to *Lick Observatory Bulletin*, No. 408 He has prepared statistics on all the comets for which good determinations of magnitude are available, they are 94 in number. There is shown to be a strong correlation between brightness and period, those of short period being less luminous. It is assumed as a working hypothesis that all comets came into existence at the same time, and that those of shorter period, having approached the sun more frequently, have suffered greater disintegration. It is found that the comets of extremely small perihelion distance do not conform to the regression line given by the other comets, which is tolerably straight. It is concluded that some special action, such as partial evaporation of the nuclei, comes into play at these small distances. It also appears from the statistics that the proportion of light due to the nucleus alone is greater for the comets of short period, indicating that these have lost a larger proportion of their gaseous envelopes.

The indicated rate of loss leads to the conclusion that comets cannot be original members of the solar system, the age of which is estimated at thousands of millions of years Mr. Bobrovnikoff estimates their age at about a million years, and concludes that they were all introduced into the solar system at the same time. He endorses a conjecture which F. Nolke put forward in 1909 that comets were introduced into the solar system at a time when the sun was passing through a nebulous region in space. There are great difficulties in seeing how they could fail to describe hyperbolic orbits in this case Friction with the surrounding nebula could not be invoked, for all adjacent regions of the nebula would have the same acceleration towards the sun. Nor could resisting medium in the solar system be invoked, as a million years is so small a fraction of the age of the solar system that the density of such a medium would not be appreciably greater then than now. The number of close approaches to planets would be far too small to explain the great host of comets.

However, every attempt to explain the origin of comets is accompanied by grave difficulties. The present paper undoubtedly establishes some important points, and advances our knowledge on the subject even if we hesitate to accept all its conclusions.

STELLAR PARALLAXES WITH THE YALE TELESCOPE AT JOHANNESBURG.—Dr. H. L. Alden, who with Mr. O'Connell is conducting the photographic determination of stellar parallaxes at Johannesburg, publishes his first list of fifty stars in *Astro. Jour.*, No. 921. It is satisfactory to note that the parallax found for Alpha Centauri, which is 0 755″ for the mean of the components, is in almost perfect accord with Gill and Elkin's value obtained with the Cape heliometer. That for Proxima Centauri is 0·783″; as this exceeds the value for Alpha in nearly the same ratio as the proper motion does, it confirms the conclusion that Proxima belongs to the Alpha Centauri system.

After this system, our next nearest neighbour is the Barnard star, for which Alden gives the parallax 0 555″. The next largest parallax on the present list is that of Epsilon Indi 0·286″; the parallax of this star was previously regarded as rather uncertain, so the new determination is welcome. There are on the list two other stars the distance of which is less than five parsecs, these are 70 Ophiuchi, parallax 0 209″, and Omicron 2 Eridani, 0 200″.

All the parallaxes are relative, and need to be increased by about 0 005″ to reduce to absolute values. The negative value − 0 005″ was found for Alpha Orionis; this confirms the fact of its great distance and huge size. The number of plates used for each star varies from 15 to 23; the average probable error of a parallax is 0·0068″.

Research Items.

MAGIC IN BENGAL.—The *Indian Antiquary* for April and May contains a study on magic in Bengal by Dr Biren Bonnerjea Magic was largely practised by the ancient Hindus and survives to a considerable extent among the modern inhabitants of Bengal Iron is one of the principal weapons against evil spirits. They will not touch anyone who has anything of iron or steel on them, and a married woman is safe from them because of her bangle of iron, which is usually covered with gold. A pair of betel cutters is kept under the pillow of a sleeping child, and when a woman dies in child-birth a nail or piece of iron is hidden in the folds of her dress so that her spirit may not return and take away her child. A traveller may contract dangerous infection from strangers; hence anyone returning from, say Europe, must be purified by the ceremony known as Prâyaścitta, consisting in the polling of the hair and eating, or at least touching with the lips, of cowdung Ambassadors of native princes, on returning from England, have been considered so polluted as to require to be re-born In Chittagong at a difficult child-birth the doors must be thrown open, corks taken from bottles, and dogs and other animals set free. Amulets made of the teeth and claws of tigers and crocodiles are worn because these are the most dangerous of the animals of Bengal. To ensure the health and well-being of a child during the coming year, water is poured over it on its birthday through a sieve which contains ten different kinds of flowers and leaves and bits of gold or silver Many of the simple acts of life have peculiar rituals of their own For example, a woman who cleans out her ears after nightfall runs the risk of bodily injury, but she may do it with impunity if she asks the permission of anyone present If she is alone, she asks permission of the wall. A precaution against the dangers attendant on the common acts of life is to snap the thumb and middle finger of the right hand

EDENTATES OF ARGENTINA.—The University of Buenos Aires has published a monograph on "Los 'Edentata' Argentinos," submitted by José Yepes for the degree of "Doctor en Ciencias Naturales" (*Revista Univ. Buenos Aires*, Ser. 2, Section 5). The work, which contains short descriptions and summaries of the distribution within the Argentine and beyond it, and full synonymies, is well illustrated and forms a handy guide for the identification of the various forms Several of the species of the South American edentates have developed well-marked geographical races, so that the number of forms of this odd group now distinguished in the neotropical region numbers sixty-eight. Many of these are widespread, so that Argentina contains in all nineteen forms, of which only six are peculiar to it. The most outstanding of these, since they represent distinctive genera, are *Chlamyphorus truncatus* and *Zaedyus pichiy*, but *Chœtophractus*, all the four forms of which occur in the Argentine, is also a genus of restricted distribution, confined to that republic and Bolivia.

EMBRYONIC MORTALITY IN FOWLS.—Even under the best conditions, the poultry farmer suffers a considerable loss from mortality among embryos during incubation. Mr F. B. Hutt and Dr. A W. Greenwood have made an investigation into the causes of such mortality and have examined more than 12,000 eggs which failed to hatch during incubation (*Proc. Roy. Soc. Edin*, vol. 49, Pt 2, 1929) They find that one of the major causes of failure to hatch is the malposition of the embryo in the shell. Four main malpositions are described One of these, in which the head is buried between the legs, definitely prevents the embryo from chipping the shell and so hatching The other three, by preventing access to the air chamber of the shell, hinder pulmonary respiration and so suffocate the embryo A further cause of embryonic mortality is the abnormality known as chondrodystrophy. The occurrence of this abnormality is independent of the breed of fowl, sex of embryo, and age of dam. Its incidence is highest in January and February and declines steadily to almost complete absence in June. The incidence is inversely proportional to the amount of sunshine, and it is suggested that lack of direct sunshine is a factor in the etiology of the abnormality. There is a suggestion that the causal agency is an hereditary physiological abnormality in the dam A further percentage of the embryos in the eggs which failed to hatch were actual monstrosities The various types are described and their frequency noted. There is a decline in the incidence of monstrosities from February to June. Ninety-three per cent of the monstrosities were characterised by various degrees of abnormality either in the brain, cranium, or eyes, or in the combinations of these organs It is suggested that monstrosities are caused by the arrest of the development of the embryo at a critical stage, probably by the chilling of those eggs laid in the early stages of gastrulation

PHYSIOLOGY OF THE EMBRYONIC DEVELOPMENT OF EARTHWORMS.—While there is a considerable literature on the morphological side of development of Oligochæta, the physiological processes of the development have never been studied, and a recent paper by P. G. Svetlov (*Travaux du laboratoire zoologique et de la Station zoologique de Sébastopol*, Académie des Sciences, Leningrad, Série 2, No. 13; 1928) contains much of interest in this respect, while the morphology of embryonic development is also treated very fully. Of particular interest are the observations made by the author on the osmotic pressure of the fluid in the cocoons of the two species studied. It was found that in *Bimastus constrictus* Rosa the osmotic pressure is very low, while in *Eisenia fœtida* Sav. it is almost as high as in the blood of adult worms Osmotic pressure in the cocoons of both species is closely connected with that of the environment, that is, that of the soil water; this necessitates the presence in *B. constrictus* of a special apparatus for regulating the osmosis (osmo-regulating blastomeres); in the case of *Eisenia fœtida* this apparatus undergoes a reduction because this species has a high osmotic pressure little influenced by the external conditions. On the whole, however, the embryos of both species are not particularly well adapted to the osmotic conditions of their environment The importance for ecological studies of the osmotic relations between cocoons of earthworms and the environment is strongly emphasised by these observations.

GERMINATION AND VIABILITY OF FERN SPORES.—Whilst studies of seed viability and the effect of external conditions on seed germination abound, similar studies upon the unicellular spores of ferns are much less numerous, although such studies may throw considerable light upon the physiological problems connected with the maintenance of viability and conditions for germination, etc. The very extensive studies by F. Okada, described in the *Science Reports* of the Tôhoku Imperial University, Vol. 4, No. 1, series 4, of the germination of the spores of five species of ferns and the retention of viability

under different conditions are, therefore, particularly welcome. Okada finds that the spores of *Equisetum*, which rapidly lose viability under almost any conditions of storage (10-24 days under laboratory conditions), contain nearly 50 per cent water on fresh weight, whilst the much more durable spores of *Woodwardia* (174-191 days under laboratory conditions) contain only about 6 per cent water. The spores of several species of ferns failed entirely to germinate in complete darkness; the spores of *Equisetum arvense* and *Osmunda japonica* would grow under these conditions. The catalase content of the spores was examined and in every case it diminished with increasing age.

YEAST FROM A THEBAN TOMB.—The principal feature of the current " Jahrbuch " of the Gesellschaft fur die Geschichte und Bibliographie des Brauwesens, E.V (Institut fur Garungsgewerbe, Berlin) is an article by Prof. J. Gruss on the contents of a beer jar from the tomb of Wah, a Pharaoh of the eleventh dynasty. Mr. H. E. Winlock, the leader of the expedition from the Metropolitan Museum of Art, New York, which opened the tomb in 1920, considers that although the jar was found on its side, it was probably upset when the stopper blew off, and the contents are therefore almost certainly 4000 years old. The microscopic examination is illustrated by twelve plates, and revealed diatoms probably from the Nile water, aluminium silicate crystals from the pottery, cloth fibres, starch grains, and fragments of emmer. Bacilli, pediococci, diplococci, and citromycelia were also found, and in addition an autogenic yeast similar to Digora, which Prof. Gruss has named *Saccharomyces Winlocki*. It is distinguished by elliptical or round cells 5 μ in diameter and has a close-grained plasma and nuclear vacuole. The yeast was also found with *Schizomyces ducens n. spec.* and aleurone cells in pieces of beer-loaf from the same tomb, and it is noteworthy that these pieces are contemporaneous with bread in the Berlin museum found in the tomb of Mentuhotep in the same cemetery. The chemical analysis of the loaf indicates the addition of honey for sweetening purposes and of a fruit of the *Citrus Aurantium* type to produce bitterness. The same publication also contains several interesting articles on the medieval monastic breweries of Germany, and a note by F. Schuster on the ' ferula ', a carved wooden sceptre which was formerly the symbol of the skilled brewer in Germany. Apparently the name is derived from the plant *Ferula L.*, a variety of fennel, the stalk of which figured in Bacchus worship (Narthex), and therefore had a special significance for the brewer.

VOLUME TABLES FOR INDIAN TIMBER.—It is only during the present century that the preparation of growth and volume statistics has been commenced in the forests of the British Empire , and its inauguration was due to the Indian Forest Service. Statistics of the kind are now available for some of the more important timber species of India and Burma, such as deodar, sal, and teak. In a recent number of the *Indian Forest Records* (vol 13, Pt. 3, Sylviculture Series; 1928) commercial volume tables for sal (*Shorea robusta*) in the wet mixed forests of the Bengal Duars are published Several volume tables for this species are already in existence, but they relate chiefly to the growth of this tree in the drier climate of the United Provinces The latter tables, it is considered, can be safely applied to the drier types of Bengal sal forest, as also to similar forest in Assam. They are inapplicable, however, to the moist type and it is for this latter that the new tables are designed. The preparation of such tables involves considerable field work in connexion with the measurement of the crops on selected areas of forest, work in which the compiler, Mr. Parma Nand Suri, statistical assistant to the sylviculturist of the Research Institute, was ably assisted by the local forest staff. The same officer has also prepared (*Indian Forest Records*, vol. 13, Pt. 4; 1928) a set of tables, the first of their kind, for the sundri (*Heritiera Fomes*) in the Sundarbans, the Gangetic delta south of Calcutta. These tables have been drawn up for the two types of sundri forest, the salt-water type and the fresh-water type. They should prove of great assistance in estimating the outturn of coupes and volume of growing stock. In connexion with the Sundarbans sundri volume tables, Mr. H. G. Champion, sylviculturist at the Research Institute, writes in a preface: " Since the work was begun there has been published *Burma Forest Bulletin* No. 15 (December 1926), a quarter girth volume outturn table for this species, for the Delta division of Burma. . . . There is a very fair agreement in the small overlapping portion, suggesting that if larger trees are grown in the Sundarbans the Burma figures may prove useful." Both pamphlets are illustrated and furnish evidence of the great strides made in the scientific aspects of forest work in India.

PROGRESS OF SURVEYING IN INDIA.—The Report for 1925–26 of the geodetic branch of the Survey of India, which is dated July 1928, has a record of much work. Geodetic triangulation was resumed with work in Lower Burma, after an interval of eight years. Previous work in that area dated from 1875. High precision levelling occupied several detachments. Tidal observations with automatic gauges were continued at eight ports. There are now more than fifty stations in Indian waters, including the Persian Gulf and Red Sea, at which automatic tidal observations have been taken for a number of years. Among other interesting matters on which the report touches is the value of bench-marks on trees. In Canada such bench-marks have been used. Their constancy has not been tested with any permanent mark of the land established in precise levelling, but the topographical survey does not disfavour their use. At Dehra Dun experiments have been made on tree bench-marks and eleven of them have been connected at intervals, during twelve years, with the standard bench-mark in the Geodetic Office grounds. The conclusions of those tests are that for secondary precision, as in irrigation work, a tree bench-mark is sufficiently good, but is not constant enough for lines of high precision. In all cases the mark should be placed on the heart wood and not on the bark of the tree.

OIL AND GAS IN WESTERN CANADA.—The economics of the Canadian oil industry have changed much since the two well-known volumes on petroleum and natural gas in the Dominion, by F. G. Clapp, were published in 1914–15 Then it was the eastern provinces which were mainly responsible for production, especially Ontario With the gradual decline of these eastern fields, however, attention is naturally being concentrated on the more westerly developments, and the performance of " Royalite No. 4 " well in the Turner Valley Oilfield, Alberta, 1924, which raised this province to the leading position of production in the Dominion, a position since maintained, has naturally had a strong influence in reviving interest in this region. Alberta has always swayed popular feeling, equally scientific interest, by its famous gas-fields, but search for large oil-pools has not often proved encouraging, save the instance cited. It is characteristic that new possibilities of oilfield development in the western hemisphere should be the occasion of renewed literary activity, so that the bulletin now appearing under the above title from the pen of

G. S. Hume (Department of Mines, Canada) has for some time been anticipated by oil technologists. It is also characteristic that such bulletins should include what we may term 'chapters of instruction for the uninitiated', a kind of condensed text-book outlining the general features of oil-origin, occurrence, accumulation, structures, and so on, much as occurs in the previous volumes cited. A modern note in this 'text' is struck by a chapter on geophysical methods for locating oil, but it is doubtful whether this 'outline' would do more than confirm an inexperienced operator in the opinion that the subject was far beyond his (the operator's) comprehension; technically, such a chapter is too brief and sketchy to be of any value. The descriptions of the oil and gas fields of the western provinces are more to the point, though unnecessarily burdened with detailed well-logs The maps and sections given are, however, most valuable, and the description of the Turner Valley field particularly good.

QUANTISED TRANSITIONS.—In the correlation of the terms of line spectra with the stationary states of atoms, considerable use is made of a number of quantum rules that express the possibility and the probability of various types of transitions A generalisation of the theory upon which these are based has been made by J A Gaunt in a paper in the May issue of the *Proceedings of the Royal Society*, on the relativistic theory of an atom with many electrons He finds that the 'selection rules' are valid if there are no external fields, the rule '$\Delta\Sigma k$ is odd' is equally rigorous, even in a uniform magnetic field, and that the 'summation rule' for the intensities in a multiplet is true to a first approximation The greater part of Mr. Gaunt's paper is of a general nature, but one practical point to which he refers specifically is of some significance in astrophysics. Certain lines of nebular spectra have been attributed to forbidden transitions between stationary states of the doubly charged ion of atomic oxygen; if they have been correctly identified, it would seem that their emission must occur in an electric field or in a non-uniform magnetic field, since they have $\Delta\Sigma k$ equal to zero.

REFLECTION CAUSTICS.—A note in the *Transactions of the Optical Society* (vol 30, p 134) from the Optics Department of the National Physical Laboratory contains an interesting set of photographs of reflection caustics, which were obtained by the double reflection of light within a photographic lens The reproductions, in spite of the fact that they do not show all the finer details of the original, include a number of beautiful patterns, mostly built up of various elliptical and cusped curves, and are of considerable interest as illustrations of an aberration which is not often encountered now in optical instruments. The usual absence of this effect, it is suggested by the authors—Messrs T Smith, J. S Anderson, and L. C Cordle—is possibly due to the fact that the main interest is now centred in systems so well corrected that faults of this type are masked by diffraction, and the caustics only reappear when the lens is used under conditions different from those for which it was designed. The same issue of the *Transactions* contains a pair of coloured reproductions of the appearance presented by a test-bar when examined in plane polarised light and in circularly polarised light in the Coker strain testing apparatus, which are also of considerable educational value.

MAGNETOSTRICTION.—The phenomena of magnetostriction are anomalous in that, in spite of the way in which they are observed, they are far too large to be explained by purely magnetic forces. The corresponding difficulty which arises in connexion with Weiss's molecular fields in iron and similar bodies has recently been removed by Heisenberg's theory of ferromagnetism, which is based upon the 'exchange' properties of electrons, and it has now been shown by R. H Fowler and P Kapitza that the same theory can be extended, with very little elaboration, to include all the essential facts of magnetostriction and the phenomena of the Curie point. One striking feature of their paper on this subject in the issue of the *Proceedings of the Royal Society* for May 2 is the scarcity of accurate experimental data by which the theory—in itself still far from complete—can be tested So far as magnetostriction is concerned, experiment does appear to be well ahead of theory, but the measurements of the allied change in the size of specimens when they lose their intrinsic magnetisation at the Curie temperature are particularly unsatisfactory The experimental values for the changes in the specific heat at the Curie point are also perhaps uncertain, although they do suffice to show that nickel has probably one magnetisable electron per atom, whilst iron and magnetite have two or three effective electrons, the latter both being cases for which the quantum analysis has still to be constructed Heisenberg's theory will require to be considerably extended before it can account for all the complex features of ferromagnetism, but it has certainly already removed the subject from its previous somewhat isolated position, and has at the same time emphasised the need for further experiment and indicated the lines upon which it should be attempted

SOME PHYSIOLOGICO-OPTICAL EXPERIMENTS.—Prof Bohuslav Brauner has recently communicated to the Bohemian Academy of Sciences a paper describing some remarkable physiologico-optical experiments which he first made fifty-five years ago under the inspiration of Helmholtz. He afterwards discussed them with the late Prof. Deyl, a prominent Central European ophthalmist, who was impressed by their novel character, and as they have never been published, Prof. Brauner was persuaded to lay them before the Bohemian Academy The first to be described relates to 'artificial blindness', which can be induced by 'throwing' the image of a well-illuminated body upon the 'blind spot' of the retina. Thus, when the image of the moon is projected upon the 'blind spot', total blindness results in a few seconds. Other remarkable experiments concern the visibility of the observer's eye and stereoscopic results without the use of a stereoscope (results acquired after some practice in making the axes of the eyes parallel or crossed as circumstance and effect demand) In this connexion one of the experiments described is an amplification of an observation by Pouvilliers (see NATURE, April 14, 1923, p 511). It appears that when two identical contour maps placed side by side with their centres 62 mm. apart were observed with the axes of the eyes nearly parallel, a double, superposed picture, much larger than the originals, is observed in the middle, apparently below the level of the paper. The mountains stand out higher according to their contours, so that a relief map is obtained. When viewed with crossed axes the combined picture is apparently much smaller than the originals, both of which are here pushed farther apart and appear relatively larger. In this instance the summits of the mountains appear as funnel-shaped depressions It would seem that some of the effects obtained by Prof. Brauner can be explained by the fact that the accommodation of the eyes changes automatically with the change of the angle of the ocular axes.

South Africa Meeting of the British Association.

Programmes of Sections.

Mathematics and Physics

At the forthcoming South Africa meeting, Section A (Mathematics and Physics) will be under the presidency of the Right Hon. Lord Rayleigh. Representatives from Great Britain of all branches of the Section will support him and will communicate papers in the two centres of the meeting, Cape Town and Johannesburg Prof Hevesy, who is a foreign guest, will open a joint discussion with the Section of Chemistry on quantitative chemical analysis by X-rays and its applications, and a second joint meeting, in this case with the Section of Geography, will be held for a series of papers on geodesy and surveying. Recent work on atomic nuclei will be described by Sir Ernest Rutherford and Dr. Aston, and spectroscopic papers presented by Prof. McLennan, Prof. A. Fowler, Mr. R. H. Fowler, and Mr. A C Menzies. Some aspects of the work of the National Physical Laboratory, to be dealt with by Dr. Ezer Griffiths, should bring to the notice of South Africans the important part played by the Laboratory in the scientific and industrial life of Great Britain. In Cape Town itself, some interesting communications are expected from Prof Ogg and his colleagues in the University of Cape Town.

Cosmical physics, already strongly represented in South Africa itself, will receive the aid of Prof de Sitter as a foreign guest, the Astronomer Royal, Prof. Eddington and Prof. Chapman. Lastly, the claims of mathematics will be met by papers from Sir Gilbert Walker, Mr. F. P. White, and Dr. Wrinch.

Chemistry.

The address of Prof. G Barger, as president of Section B (Chemistry), will be delivered at Cape Town, and is entitled "Applications of Organic Chemistry to Biology". Organic and biochemical subjects occupy the major portion of the Cape Town programme. Prof. K Freudenberg, of Heidelberg, will give a lecture on "The Vegetable Tannins", a subject of special interest in South Africa, and it is hoped to hear an account of "Essential Oils from South African Plants" by Prof. St. J. van der Riet, of Stellenbosch. Although the nature of vitamins from the chemical point of view was discussed so recently as the Leeds (1927) meeting, the rapid development of our knowledge of the vitamins since that time makes the joint discussion with Section I (Physiology) particularly opportune On the one day at Cape Town devoted to general and inorganic chemistry, Dr N V. Sidgwick will give a lecture on "Chemical Linkage" and Prof. J. Smeath Thomas, of Cape Town, will give an account of "Recently discovered Nitrate Deposits in S.W Africa". From Cape Town it is hoped that the Section will have the privilege of visiting the factory of The Cape Explosives Co. at Somerset West.

The sectional programme at Johannesburg is to be devoted almost entirely to inorganic and physical chemistry. Mr H. A White, of the Geduld Proprietary Gold Mines, Ltd, is to give an account of "The Chemistry of Gold Extraction", and two special features of the Johannesburg programme are a joint discussion with Section A (Physics) on "Qualitative Analysis by X-rays" to be opened by Prof G Hevesy, of Freiburg, and a lecture by Prof E C. Franklin, of Stamford University, California, on "The Ammonia System of Compounds". Mr A. C. Egerton is to give an account of "The Influence of Antiknocks on the Combustion of Hydrocarbons", and other important contributions to the programme are being made by Prof. H. Bassett and Dr. F. H. Constable

Geology.

The organisation of Section C (Geology) has been necessarily affected by the meeting of the International Geological Congress at Pretoria, and a programme has been adopted which, while enabling the section to carry on its work with the Association, yet allows its members to take some part in the proceedings of the Congress Two sessions will be held at Cape Town and two at Johannesburg. Members of the Congress who wish to be present and take part in the proceedings at Johannesburg will be able to take advantage of the invitation which has been extended to them.

Sir Albert E. Kitson, of the Geological Survey of the Gold Coast, president of Section C, will deliver his address at Johannesburg on "The Utility of Geological Surveys to Colonies and Protectorates of the British Empire".

The special position that Africa takes in all questions involving continental drift makes the joint discussion with Sections D (Zoology) and K (Botany) specially appropriate Phases of the problem may be touched in the papers by Prof W. T. Gordon on "Some Limestone Erratics from the Beardsmore Glacier", and Mr. W N. Edwards on "Triassic-Rhætic Floras of the Southern Hemisphere". Dr. F. Dixey will describe the geology of the Lower Shire-Zambezi Basin, and Mr. F. P Mennell will put forward "Some Suggestions as to the Origin of the Diamond Pipes". Of wider interest is the paper of Prof P. G. H. Boswell on "The Precipitating Action of Colloids on Fine-grained Sediments": this opens a new field of investigation.

As is usual with Section C, the excursions are a feature of the programme As these have been arranged by Dr. A. L. Hall, of the Union Geological Survey, and secretary of the International Geological Congress, their interest and importance is assured Two half-day and one whole-day excursion will be made in the neighbourhood of Cape Town. The journey from Cape Town to Johannesburg will be spread over four days, with stops at Laingsburg and Kimberley. Between the two sessions at Johannesburg members will be able to join the Congress for the Witwatersrand excursion (three days).

Geography.

The president of Section E (Geography) for the South Africa meeting is Brigadier E M. Jack, Director-General of the Ordnance Survey, who will deal with "National Surveys" in his presidential address. Following this a series of papers will be read by Capt. McCaw, Dr. Van der Sterr, and others, dealing in further detail with cartographical and survey problems relating to Africa in general, and to South Africa in particular In connexion with these, it may be recalled that at the Glasgow meeting the Section emphasised the importance of completing, as soon as possible, the survey of the arc of the thirtieth meridian, and urged also the need for the publication of a uniform series of maps of Africa on a scale of 1 : 2,000,000, as the only satisfactory base for various distributional studies in Africa. The significance of the latter will be further developed, along with other points, in a report to be presented by Mr A G. Ogilvie of a special committee which has been investigating problems connected with the geography of tropical Africa.

Various aspects of South African geography—both physical and human—will be analysed, both at Cape Town and Johannesburg, by local authorities, including Prof J H Wellington and Prof E. Walker. At Cape Town, Mr Van Reenen, chairman of the

Irrigation Commission, will review various problems connected with the utilisation of available water supplies in South Africa, while Prof. Serton will examine critically the extent to which the term 'desert' may be justifiably applied to various regions of low rainfall (for example, the Western Karroo, with an average annual rainfall of less than 5 inches in parts).

A meeting in a region of winter rains such as south-western Cape Colony provides a fitting opportunity for a critical survey of "the Mediterranean Climatic Type, its World Distribution and the Human Response", which Dr. Marion Newbigin proposes to undertake. The various important problems connected with the South African sector of Antarctica will also be presented in a paper prepared by Mr. F. Debenham, and it is hoped that General Smuts will take part in the discussion on the matters raised.

The position of geography in South African education is not all that can be desired, and attention will be directed to this important aspect in a joint discussion that has been arranged with Section L at Johannesburg, a whole morning being devoted to the question.

Outside of Africa various interesting papers are being presented dealing with parts of both the southern and northern hemispheres. The significance of China's expansion in the Far East is to be considered by Prof. P. M. Roxby, while among the papers on Europe will be one by Prof. H. J. Fleure analysing the significance of various city types in the interpretation of the different cultural regions of the Continent.

Dr. Vaughan Cornish's interest in the æsthetics of scenery is now well known in Great Britain, and a paper by him on "The Rural Scenery of England and Wales" will be welcomed in South Africa

ECONOMIC SCIENCE AND STATISTICS.

THE programme for Section F (Economic Science and Statistics) of the British Association has now been arranged for the forthcoming meeting in South Africa, and, as was to be expected, special attention is to be devoted to those economic problems which are of importance in the Union. Labour questions, for example, are to be discussed in the light of South African conditions, and for this purpose a joint discussion has been arranged with the Anthropological Section on "Economic Competition between Advanced and Backward Peoples", while Prof. A. Leslie is to speak on "Coloured Labour and Trade Unionism in Cape Town". Another economic topic of considerable importance to South Africa is the marketing of agricultural produce and the joint meeting which has been arranged with the agriculturalists on "The Problem of Stabilising Agricultural Prices, with special reference to Control Boards, Equalisation Funds, and other methods of Price Regulation", should lead to an interesting discussion. It is anticipated that Mr. R. B. Forrester, Dr. Tinley, and Mr. R. J. Thompson will participate in this discussion. At Johannesburg, Dr. J. E. Holloway is to speak on "Population Problems of South Africa", while Mr. W. H. Clegg will describe "South African Banking".

ENGINEERING.

ENGINEERS attending the South Africa meeting of the British Association will have papers and discussions at both Cape Town and Johannesburg. The president of Section G (Engineering), Prof. F. C. Lea, will deliver his address at Johannesburg.

The principal subjects chosen for papers are of great importance to South Africa. At Cape Town Dr. Ezer Griffiths, of the National Physical Laboratory, and Mr. E. A. Griffiths, of Cape Town, will give papers on recent research work carried out in England and South Africa in refrigeration. The successful export of fruit from the Union depends largely on this work.

The importance of transport, which is as great in South Africa as in any other country, will be dealt with from many different angles by English and South African authorities Sir Henry Maybury will describe the developments which have taken place in Great Britain during the past few years, referring to the effect of recent legislation on road administration Papers dealing with transport costs, alcohol fuels, railways, and roads as feeders to the railways will also be given. Sir Henry Fowler's paper will describe chiefly the work of the Directing Committee, of which he is a member, appointed by the British Government to study aspects of mechanical transport likely to further the economic development of the oversea Empire, and it is hoped that the discussions on these papers will be of great help to this committee.

At Johannesburg cheap power will be dealt with. Sir Charles Parsons will give a description of the more recent developments in steam turbine practice, chiefly in regard to the increased output per unit.

Prof. E W. Marchant's paper on the limits of the economical transmission of electrical energy will have an added interest, for at the last South Africa meeting of the Association the late Prof. Ayrton made an important contribution on the transmission of power from the Victoria Falls Mr C H Merz will describe the development of the national scheme of electricity supply in Great Britain, and discuss the anticipated economies and the probable effects of the cheapening of electric power on the distribution of population and industries

The acute problem in mining in South Africa is the cooling and ventilation of the deep mines, and the joint discussion of the Engineering and Physiological Sections on deep mine ventilation, to take place at Johannesburg, should prove very valuable.

ANTHROPOLOGY

SOUTH African anthropologists have prepared a full and interesting programme for Section H (Anthropology), in which archæology figures largely. There is ample evidence, however, that other branches of the science are not neglected in the Dominion, and it has been necessary to make arrangements for a subsection at Johannesburg to provide for a number of papers on physical anthropology by Prof Dart and other members of the Anthropological School which centres in the University of the Witwatersrand. At Cape Town especial interest will attach to a series of papers on the Fish Hoek Caves, which will be followed by a visit to the caves themselves The meeting at Cape Town will, however, be curtailed to allow the members of the Section to proceed in advance of the main body to Kimberley, where the collection of skulls and archæological exhibits in the Museum will be visited, Mr Cronin's remarkable collection of photographs of South African natives will be viewed, and archæological excursions in the neighbourhood will be made.

The programme at Johannesburg will be particularly interesting. Prof. Dart will exhibit the Taungs skull, and arrangements have been made for a visit to the site of discovery. Mr Leakey will describe his discoveries in the prehistory of East Africa, and Mr. Wayland will deal with the present position of Stone Age research in Uganda Mr. C. von Riet Lowe will deal with the archæology of Sheppard Island, with an addendum on the associated fauna, and Prof. Dart will describe mammoths and other fossil elephants of the Transvaal, some of them not previously known.

The question of Bushman rock engravings will be discussed by Miss Wilman, a subject on which much illuminating discussion may be expected, in view of

the visit of L'Abbé Breuil to South Africa as a guest of the Association and the demonstration of the Late Palæolithic art of Spain which he will give at Cape Town. Members of the party proceeding from England—Prof Fleure, Prof. Ruggles Gates, Miss Murray, and others—will contribute to the proceedings.

The items in the sectional programme, however, which are expected to arouse the keenest interest are the papers centring around Zimbabwe. Dr Leo Frobenius will give an account of the explorations of prehistoric Rhodesia made to date by the expedition of which he is leader. He will be followed by Miss Caton-Thompson, who will describe the results of the work, undertaken at the request of the Association, which she has carried out at Great Zimbabwe and on which she has been engaged since the beginning of the year on behalf of the Association

PHYSIOLOGY.

SECTION I (Physiology) this year includes in its programme one or two unusual items. Probably the most striking is a joint discussion with the other biological sections on "The Nature of Life", which General J. S Smuts has promised to open. Among the other speakers on this topic are Profs D'Arcy Thompson, J. S. Haldane, Wildon Carr, and E. C C Baly. That an agreement will be reached is more than can be expected, but it is certain that much of interest will be said.

The Capetown part of the programme also includes joint meetings with Section D on experimental biology, one morning being mainly occupied by papers on this subject, and an afternoon being devoted to demonstrations on kindred topics in Prof. Lancelot Hogben's new laboratory. Many of the contributions, both here and at Johannesburg, are from South African workers, and the matters discussed range over a wide field

At Johannesburg the most important feature probably is a joint discussion with Section G (Engineering) on "Problems connected with Deep-mine Ventilation". The economic importance of this matter is very considerable, and it is hoped that members of the Transvaal Mining and Metallurgical Society will also be able to participate.

Of almost equal interest to physiologists and to economists is "The Problem of Dust Inhalation", on which also a discussion has been arranged. The sectional programme is now, however, restricted to questions connected with the mining industry. Papers are being contributed by local workers on the measurement and effects of ultra-violet light, and a varied programme includes a paper by Dr. Monckton Copeman on "Diet and Cancer", and a description of "The Feeding Habits of Vampyrella", with kinematograph accompaniment, by Prof. F. E. Lloyd, of McGill University.

PSYCHOLOGY.

SECTION J (Psychology) meets this year under the presidency of Mr. F. C. Bartlett, the Director of the Cambridge Psychological Laboratory, who in his address will discuss "Experimental Method in Psychology". The programme is full and varied, in it nearly every department of psychology is represented. A joint discussion has been arranged with Section L on "Psychological Tests in Relation to Education and Vocational Guidance", in which papers will be read by Prof. Reyburn, Dr C. S. Myers, and Dr. Shepherd Dawson

South African psychologists will present seven or eight papers, three of which, by Prof Wilcocks, Prof Eybers, and Dr. Fick, will report the results of investigations into the intelligence of South African children, both white and black. The philosophical aspects of psychology are represented by Prof. G. Dawes Hicks in a paper on "The Notion of Fusion in Psychology", by Prof H Wildon Carr, who will speak on "Imagination and Reasoning", and by Prof Forsyth of Bloemfontein, who will read a paper on the "Significance of Holism", a philosophical theory propounded by General Smuts

The Industrial Fatigue Research Board is represented by Mr Eric Farmer, who will give an account of some of his own work on 'accident proneness'

BOTANY.

SECTION K (Botany) has a very full programme both at Cape Town and at Johannesburg The large number of papers to be communicated by South African workers indicates clearly the very active interest which is being taken there in botany at the present time. All branches of botany are well represented in the programme. Prof Seward's presidential address on "Botanical Records of the Rocks" will be given at Johannesburg As might be expected, much time will be devoted to papers on the South African flora, and there will be a discussion on its origin and evolution, in which Dr Marloth, Prof. Bews, Prof Compton, Dr Pole Evans, Prof. Adamson, Prof Moss, and others will take part Dr. Pole Evans will also give an account of the present position of the botanical survey of South Africa Prof. F E. Lloyd will exhibit a film illustrating the mechanism of the trap of *Utricularia*, and Dr. A. S. Hitchcock, of the Smithsonian Institution, will speak on the subject of grasses in relation to man. Miss Saunders will discuss her recent work on carpel morphology.

Popular lectures will be given by Dr Margery Knight on "Seaweeds, a Study of Adaptation and Opportunity", and by Prof Priestley on "From Lake to Veld. a Study of the Water Relations of the Higher Plant". The forestry group also has an interesting programme, in which contributions from persons interested in forestry problems in South Africa are prominent Numerous excursions to places of botanical interest have been arranged.

EDUCATION.

THE programme of Section L (Educational Science) is promising and varied. Two objects have been kept in mind in its preparation: (*a*) the desirability of showing the recent development in educational administration, practice, and teaching in England; and (*b*) the presentation and discussion of South African problems.

Dr. Kimmins has chosen for his presidential address the subject "Modern Movements in Education" One session at Cape Town is to be devoted to general educational problems in South Africa, when five separate papers will be given by leading experts.

At Johannesburg a full session will be devoted to "Education and the Native Races", four papers being expected. At a joint session with Section J at Cape Town, leading psychologists from both countries will discuss psychological tests in relation to education and vocational guidance. Other sessions at Cape Town will be given to discussions on the relation of examinations to the secondary schools and on the teaching of science, including biology and botany, in schools. At Johannesburg, at a joint session with Section E, papers will be given on the teaching of geography by members from both countries

Committees of the Section will also present reports on science in the school certificate, formal training and training for life overseas

AGRICULTURE

PERHAPS the most significant development which has taken place in agricultural science is the realisation of the very close relationship between soil and animal nutrition problems as they exist in Great Britain and the various Dominions of the Empire.

The fact that much of the work in progress in the British Isles has a direct bearing on Dominion problems has resulted in a desire for closer touch and collaboration between research workers in various parts of the Empire. This trend was emphasised and focused at the Imperial Agricultural Conference in London in 1927 and practical recognition has been given by the creation in the British Isles of Agricultural Bureaux in Soil Science, Animal Nutrition, Plant Breeding, Animal Genetics, and Veterinary Science. It is fitting, therefore, that by far the greater part of the programme for Section M (Agriculture), which is meeting at Cape Town and Pretoria, should be occupied by the discussion of broad agricultural problems. Two whole sessions are being devoted to soil problems, the first at Cape Town to a discussion on soil fertility and its control, and the second at Pretoria to methods of soil investigations in field and laboratory.

A morning session will be occupied by a discussion on Empire wool growing problems with particular reference to South Africa and to the manufacturing requirements of Great Britain. Grassland and the production of stock is another problem of world-wide range, the fundamental aspects of which are similar in all parts of the Empire Major Walter Elliot will open a discussion on the mineral aspects of pasture nutrition in relation to the live stock industry, and representatives of the Rowett Research Institute, Aberdeen, and the South African Veterinary Research Station will contribute.

The possibility of stabilising agricultural prices and the methods of achieving the object in view continue to exercise the minds of farmers and economists the world over, and considerable experience has been acquired in South Africa, Canada, and New Zealand. Section M has arranged for a joint discussion with Section F (Economics) on this subject, with particular reference to the operation of control boards, equalisation funds and other methods of price regulation. Agriculture and the Empire will form the subject of Sir Robert Greig's presidential address to Section M, and the address, together with a discussion on Empire agricultural problems, will occupy the whole of the second morning session at Pretoria.

Some Function Problems attaching to Convergence.[1]

THE arrangement of the conducting paths of the nervous system, branching and redistributing their impulses as they do, exhibits places where numerous convergent paths run into one When at such places two or more of the converging arcs are concurrently active, the trains of impulses arriving by them can interact Such convergent places are co-ordination points. An example of much importance, and relatively accessible to experiment, is that in the spinal cord, where the motor nerve-cells innervating a muscle receive as a group the various afferent paths which reflexly operate the muscle. If two or more of the convergent afferent nerves are excited concurrently, the reflex interaction, as revealed by the muscle, exhibits three main sets of cases

In one set of cases the muscular response under concurrent stimulation of two or more afferents shows a deficit in amount as compared with the sum of the responses obtainable from the several afferents taken separately This occurs especially when the excitation of the reflexes is strong; it is most marked when they are of maximal strength The contraction effect of one afferent may default altogether. The result might seem to indicate inhibition, but analysis shows that it is not referable to any form of inhibition.

The explanation lies in the limitations of the mechanical response of the muscle fibres of the motor-units activated: the contraction effect pertaining to one afferent being 'occluded' for the time being by that pertaining to another. 'Occlusion' is a result of the overlap of different afferent arcs upon the same motor-units: this overlap is 'central', for example, in the spinal cord The amount of 'occlusion' as observed by the myograph gives a measure of the amount of that 'central' overlap. In such estimates, however, the assumption is made that the component motor-units of the muscle all of them possess individually the average value of contraction-tension which obtains for them. This in the knee-flexor (cat) semitendinosus has a value which is only one-third of that obtaining for gastrocnemius. It is, however, certain that the individual motor-units differ considerably in contraction-value within one and the same muscle Examined by occlusion, the overlap of the constituent branches of a single large afferent nerve upon its motor-units can be well above tenfold. This gives a functional picture in harmony with the histological picture furnished long since by Cajal

In another set of cases, on the contrary, the contraction response of the muscle, under concurrent stimulation of two or more reflex arcs which are excitatory for it, shows a surplus of contraction as compared with the sum of the responses to the component afferents taken separately This result is most evident with weak reflexes As with the other set of cases this result also, although opposite to the previous class, brings evidence of the overlap of the convergent arcs upon the central ends of motor-units held by them in common Moreover, evidence is thus furnished that central states of excitement, individually too weak to provoke the motor-units into discharging activity, can by summation become effective for that activation.

The reflex excitation provoking contraction of the muscle is shown to be accompanied regularly in the spinal centre by concomitant subliminal excitation in other spinal motor cells over and above those excited to actual discharge. The time relation of central subliminal excited states obtaining in certain typical reflexes has been determined (J. C. Eccles). By the summation of subliminal excited states this fringe of subliminal effect is a functional means of liaison enabling co-operation between different adjuvant parts of the nervous system Although the neuron upon which convergent arcs interact is subject to their combined influence, and is to that extent an instrument passive in their hands, it is an instrument clearly with ways of its own Thus, to receipt of a single stimulus it may react by a response consisting of a whole tetanic series of impulses.

Another and third set of cases arising from interaction at the convergence point is where the upshot is inhibition The clash is between 'central' excitation and a central process which arrests or precludes it, but about which all that is known is that it antagonises excitation. Evidence was adduced of the

[1] Summary of the David Ferrier Lecture delivered before the Royal Society on Thursday, June 20, by Sir Charles Sherrington, O M, F R S

quantitative interplay of the opposed influences upon the individual neuron Conditions favouring inhibition were discussed

Though trains of impulses are the sole reactions which enter and leave the central nervous system, it is clear that nervous impulses are not the sole reactions functioning within that system. States of excitement which can sum together, and states of inhibition which can sum together, and states which represent the algebraical summation of these two, are among the central reactions. The specific cell units, the neurons, far from behaving merely as passive recipients and transmitters of impulses, modify as well as transmit what they receive.

Joint Russian-German Expedition to the Pamir.

A JOINT expedition to the Pamir was organised last year by the Russian Academy of Sciences and the Notgemeinschaft der Deutschen Wissenschaft, consisting of eleven German members and about thirty Russians representing various branches of science, under the leadership of N. P. Gorbunov. The expedition started in June from Osh (in Turkestan) and went through Gultcha into the Alai valley, then across the Transalai ridge to the alpine lake Kara-kul, from there various sections of the expedition radiated in different directions, and the field work went on until November. Scientific results of the expedition will take some time to work out fully, but a preliminary account, as published in the *Information Bulletin* of the Russian Academy (No. 3-4, for 1929), already gives some idea as to their value.

The geographical section of the expedition collected exhaustive information on the areas traversed. Of particular interest was a study of Fedtchenko's glacier, which has been found to extend for more than 75 km., that is, it ranks amongst the largest glaciers in the world. The topographical section accomplished the enormous task of surveying the wide expanse of Pamir, most of the work had to be done at the altitudes exceeding 4000 metres, which made it exceedingly difficult. Nine astronomical and twelve triangulation points were determined, and altitudes of twenty-two mountains estimated. The meteorological and geophysical section made regular meteorological, aerological, actinometric and hydrological observations; 47 geomagnetic points and 150 gypsometric points were determined. The geological section studied the history of the glaciation of the Pamir and prepared a general geological map of the area, the mineralogical collections are very rich and contain proofs of a number of useful minerals.

The zoologists of the expedition collected more than 13,000 animals, mainly insects, it was interesting to find some southern forms at very great altitudes, thus at 3700 m., scorpions, Mutillid wasps, *Ammophila*, *Bombus melamorus*, etc., were found. Experiments in hybridisation of *Ovis polii* with the domestic sheep were made and the progeny will be studied in detail. Apart from the specimens collected, a considerable number of living local animals was sent from the Pamir to the Moscow Zoological Garden The linguistic section collected materials for a dictionary of the Tadzhik language, made phonograph records of native speech, and studied native customs and folklore. The radio section of the expedition had three transmitting stations at its disposal; apart from keeping in touch with central Russian stations, it made a series of experiments relating to the transmission under the peculiar local conditions. A kinematographic section made about 9000 metres of films of all places and phases of the expedition. The Alpine section made about thirty ascents to the highest peaks of the Pamir, the greatest height reached being 7120 m. (Lenin's peak).

Scientific results of the expedition will be published in parts, as the working out of materials proceeds; it is suggested that the whole series, which will be published partly in Russian, partly in German, will be completed in 1930, apart from detailed monographs on different problems which will be published separately.

University and Educational Intelligence.

CAMBRIDGE.—The Harkness Scholarship in geology has been awarded to L. Bairstow, King's College. The Anthony Wilkin Studentship in archeology and anthropology has been awarded to J. B. Charlesworth, of Christ's College.

The following reappointments have been made F W Dootson, University lecturer in chemistry, P M S. Blackett, University demonstrator in physics, R. G. W Norrish, University demonstrator in chemistry, E M Taylor, University lecturer in agricultural chemistry, E. H B Boulton, University lecturer in forestry, H. E. Woodman, University demonstrator in agricultural chemistry; C E. Tilley, University lecturer in petrology; W A. Fell, University demonstrator in anatomy; F W Dootson, University demonstrator in chemistry.

Dr W M Smart, of Trinity College, chief assistant at the Observatory, has been reappointed to the John Couch Adams astronomership.

Frank Smart Prizes have been awarded to H. R Barnell, of Downing College, in botany, and to R. J. Pumphrey, of Trinity Hall, in zoology

The syndicate to consider the organisation and finance of the Botanic Garden has reported to the University. The most important of its recommendations are the following:

(1) The Botanic Garden should become an integral part of the Department of Botany, and the responsible head of the Garden should be the professor of botany.

(2) The duties of the Director of the Garden should be general responsibility for the management of the Garden and particular care for its development as an aid to the study of botany.

(3) The stipend attaching to the office of Director should be variable according to the nature of the other offices held simultaneously by the Director.

(4) A new University lectureship should be created for the teaching of systematic botany.

(5) Consideration should be given to the fact that a part of the land adjoining the Garden could be sold under suitable restrictive conditions without detriment to the present or future needs of the Garden.

(6) The town of Cambridge should be invited to contribute to the cost of the Garden, so long as it is made accessible to the general public

GLASGOW.—Prof. J. W. Gregory, having attained the age of sixty-five years during the past session, has resigned the chair of geology in the University which he has held since 1904 Prof. Gregory is not subject to the age-limit regulation, but he has decided to retire to make way for a younger man and to devote his time to the completion of work in which he has been engaged.

Among others, the honorary degree of LL.D. was conferred on June 19 on: Prof. H S. Carslaw, professor of pure and applied mathematics, University of Sydney, Madame Marie Curie, of Paris; The Earl of Elgin, chairman of the Carnegie United Kingdom Trust; C. O. Hawthorne, chairman of the Repre-

sentative Body of the British Medical Association, and Lord Lugard, ex-Governor of Nigeria.

LIVERPOOL.—The Council of the University, at its meeting on June 18, elected Dr. D. B. Blacklock, professor of tropical diseases of Africa, to the Walter Myers chair of parasitology. Prof. Blacklock is a graduate of the University of Edinburgh. From 1911 until 1914 he was in turn assistant director and director of the Runcorn Research Laboratory. In 1914 he became a member of the commission appointed to investigate the problems of sleeping sickness in West Africa, and was elected to a lectureship in parasitology in the University of Liverpool During the War period he was in charge of a pathological laboratory and conducted investigations on malaria on behalf of the War Office Prof Blacklock has been secretary and a vice-president of the Tropical Section of the British Medical Association and has played an active part in the promotion of tropical medical research.

At the same meeting the Council appointed Mr E. C. Titchmarch to the chair of pure mathematics in the University, and Dr. J. H. Orton to the Derby chair of zoology. Mr. Titchmarch, a scholar of Balliol, was appointed in 1923 to a lectureship in mathematics at University College, London, and to a fellowship of Magdalen College, Oxford Since 1925 he has been reader in mathematical analysis in the University of London. Dr. Orton is a graduate of the Royal College of Science, London In 1914 he was appointed assistant naturalist at the Marine Biological Laboratory, Plymouth, and after War service returned to the laboratory, in which he was promoted in 1924 to the post of chief naturalist. He has conducted extensive research on problems of marine biology, paying particular attention to the life history of the oyster.

MANCHESTER.—A limited number of research scholarships in technology, each of the value of not more than £100, are to be awarded in July by the Manchester Municipal College of Technology. Application forms, returnable by, at latest, July 6, can be obtained from the Registrar of the College.

KING'S COLLEGE, London, celebrated during the past week the hundredth anniversary of its foundation. The celebrations, inaugurated on Tuesday by their Royal Highnesses the Duke and Duchess of York, included the dedication of the chapel and opening of the library and new wing of the Vincent Square hostel by the Archbishop of Canterbury, who is the official Visitor Beginning in 1829 with work of university standard in arts, science, and medicine, and a 'junior department' which became the present King's College School at Wimbledon, the growth of the College has been marked by the establishment of an engineering department in 1838, a hospital (now on Denmark Hill) in 1839, a theological department for the training of clergy in 1847, evening classes in 1856, a department for women (in Kensington) in 1885, and a teacher-training department in 1890. The post-War years have seen a remarkable further enlargement of its activities and increase in the number of its students, with the result that additional accommodation is urgently required, especially in the departments of chemistry and anatomy. The building scheme designed to meet this need at a cost of £125,000 will, if carried out, improve the architectural amenity of the Thames frontage in the neighbourhood of Waterloo Bridge. For this, and for the endowment of professorial chairs and scholarships the College is asking the public to subscribe to its centenary appeal fund.

Calendar of Patent Records.

June 29, 1722.—A patent was granted on June 29, 1722, to Martin Triewald, the Swedish engineer, for his invention of a "certain engine or machine for drawing water out of mines and collyeries by the power of the atmosphere". Triewald, who was in England when the first Newcomen engines were being set up and himself helped in the erection of one, built the first engine in Sweden, that for the Dannemora mines, and is the author of the earliest monograph on the steam engine, which was published at Stockholm in 1734. Triewald claims to have made improvements on the engine, but what these were and what was the construction for which his patent was granted he does not say

July 1, 1769—The stamped brass trade dates from the patent of John Pickering, whose specification was enrolled on July 1, 1769 The invention consisted of a "new method of performing that kind of work commonly called chasing in gold, silver, brass, tin, or other metal, by a machine consisting of an oblong frame with two rods, in which a moving forcer is worked upon a striking block with a die fixed thereon formed for each respective purpose, whereby the work is executed in a much more expeditious manner and far superior to anything of the kind (not being actual chasing) ever yet performed by any other means"

July 1, 1877—There was no common patent law for Germany before 1877, but for many years patents had been granted by the constituent States under their respective laws and regulations The first patent law of the German Empire, superseding the various State laws, came into force on July 1, 1877, and the first patent under it dates from the following day.

July 3, 1769.—The practical application of the principle of roller drawing in cotton-spinning is due to Sir Richard Arkwright, whose patent for the invention was sealed on July 3, 1769 Arkwright was partnered and greatly helped in the establishment of the industry which was started at Cromford Mill, Derbyshire, by Jedediah Strutt, the inventor of the rib stitch hosiery frame.

July 3, 1861.—The manufacture of mechanical wood-pulp for papermaking was the invention of F. G. Keller in 1845, but its commercial introduction and development are mainly due to Heinrich Voelter, papermaker, of Heidenheim, who was granted a Prussian patent for five years for his improved process on July 3, 1861.

July 4, 1767.—On July 4, 1767, there was granted a patent to John Winn, a shipwright of Shadwell, for a method of saving life "in case of a ship being in distress on a lee shore where a boat cannot live". Ropes were sent ashore by means of a buoy, and the passengers and crew were then transported in a basket slung on one of the ropes and hauled to the shore.

July 6, 1897.—The patent of Walther Nernst, of the University of Gottingen, for the electric lamp which is known by his name, was granted in Germany on July 6, 1897. At the time of its introduction, practically no improvement had been made in the earlier carbon filament lamp, other than in the details of the manufacturing processes, and Nernst utilised for his lighting element one of the refractory rare-earths, which allowed a current to pass after a preliminary heating, and withstood a greatly increased temperature He succeeded in reducing the consumption from the 4 watts per candle power of the carbon filament to 1·5 watts The lamp has now been very largely displaced by the metal filament lamp.

Societies and Academies.

LONDON.

Royal Society, June 13 —W. S. Stiles. The scattering theory of the effect of glare on the brightness difference threshold. The theory that the observed increase in the threshold due to the presence of a glare source in the field is caused by light scattered in the eye media, is formulated mathematically. Deductions from it are not in accord with observation. The general conclusion is that the scattering effect can play only a subsidiary part in increasing the threshold —Grace Briscoe and Winifred Leyshon: Reciprocal contraction of antagonistic muscles in peripheral preparations, using flashing neon lamp circuit for excitation of nerve Controlled and co-ordinated rhythmic movements of a limb, closely resembling natural movements, are produced by suitable artificial stimulation of cut efferent nerves If during this controlled rhythmic movement the mechanism producing phasic variation is stopped at any point, the limb remains held in posture. The method of stimulation is thus adequate for both movement and posture. An analysis of the forces controlling movement shows that the control of relaxation is as important for smooth co-ordination as the control of contraction —T Moran Critical temperature of freezing living muscle Up to 40 per cent of the water in amphibian muscle can be removed by freezing or drying, and its original state completely recovered by restoring water. On removal of 78 per cent, the muscle immediately dies The critical water removal of 78 per cent corresponds to the freezing of the muscle to equilibrium at about $-2°$ C Muscles frozen to equilibrium below $-2°$ C. undergo marked changes on thawing —E. C. Smith The formation of lactic acid in muscles in the frozen state. Freezing (that is, drying) upsets the balance, making production exceed removal. This upset is due to, or accompanied by, injury to the mechanism. Below $-1{\cdot}6°$ C the mechanism of removal is destroyed, that of production persisting. Is the mechanism of removal the 'living' part ?—F. M. L. Sheffield · Chromosome linkage in *Oenothera*, with special reference to some F_1 hybrids Most results can be brought into line with Cleland's hypothesis—absence of pairing due to lack of harmony between homologues. Chromosome linkage may be inherited as a genetic character —A C Downing and A V Hill: A new thermopile for the measurement of nerve heat-production.—A V. Hill The heat-production and recovery of crustacean nerve The heat-production of crab's nerve in response to maximal excitation is at least $2{\cdot}5 \times 10^{-3}$ calorie per gram of moist nerve per second of stimulus. This is 33 times as great as in frog's nerve The crab's nerve is highly fatiguable. The initial process, completed during stimulation, yields only about $2\frac{1}{4}$ per cent of the total heat · the recovery process, lasting for 25 minutes at 16° C, supplies the rest. In respect of fatiguability and of oxygen requirement a crab's nerve probably presents a closer analogy to certain characteristics of the central nervous system than does a frog's sciatic

PARIS.

Academy of Sciences, May 22 —The president announced the death of M. Depéret, non-resident member, and of M. Cornet, foreign *correspondant* for the Section of Mineralogy.—Léon Guillet, Jean Galibourg, and Michel Samsoen: Extension tests at high temperatures. Data are given for the elastic limits at 450° C. for various alloy steels, including nickel, nickel-chromium, and nickel-chromium-molybdenum steels. No general conclusions can be drawn from the results, but the previous heat treatment certainly has a considerable influence on the elastic characteristics at 450° C.—Eduard Čech. Some remarks relative to the differential projective geometry of surfaces.—C. Pawlowski: Remarks on the disintegration of aluminium. Discussion of the results obtained by the author and by Rutherford and Chadwick on the H-rays of aluminium —Y. Rocard. The fall of a heavy gas in a light gas. The stability of ozone in the upper atmosphere From considerations based on the kinetic theory of gases, it is concluded that the velocity of ozone in nitrogen would be 22 metres per day, and of ozone in hydrogen, 17 metres per day In either case the atmospheric ozone is practically stable.—L. Genevois The variations of the respiratory intensity and of the intensity of fermentation in the tissues of the pea.—Bounhiol Respiration in media containing an excessive percentage of oxygen. The fact has been established by previous workers that animals breathing an atmosphere containing an excess of oxygen rapidly die. Under these conditions there is a rapid increase in the proportion of urea in the blood, and the accumulation of oxidation products in the blood prevents the fixation of fresh oxygen.—L. Lutz. The soluble ferments secreted by the hymenomycete fungi. The alkaloids and the anti-oxygen function.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 2).—P. P. Lazarev Modern treatment of malignant tumours from the point of view of the ionic theory of excitation. The success of treatment of malignant tumours by calcium salts is explained by the suggestion that calcium ions inhibit the development of tumour cells, while those of potassium and sodium favour it. V. Vernadskij The concentration of radium by living organisms Radium from water solutions is absorbed by aquatic organisms, both vegetable and animal, and is concentrated there, from solutions in soil it is absorbed by terrestrial plants and from drinking water by terrestrial animals. In some cases the concentration of radium in an organism was found to exceed that in water 56·5 times.—V. Vernadskij Rare earths elements in massive rocks. Minerals rich in rare earths are found mainly in pegmatite seams, but their occurrence in the rocks proper is not clear, probably because of insufficiently exact methods of examination —V. Vernadskij. The geochemical constants of some cultivated plants Geochemical energy of the best selected varieties is less than the energy of the varieties usually cultivated. —A. Vinogradov. Chemical composition of plankton from the Ekaterininsky pond at Dietskoe Selo, near Leningrad —D. Grave Magnetic anomalies A reply to the critical note by Kravetz (*Comptes rendus*, p. 470; 1928) —N. Olenev: Systematics and geographical distribution of Ixodidæ (3). The genus *Rhipicephalus* is represented in Russia by three species, *R. sanguineus* Latr., *R bursa* Can. et Fanz., and *R. schulzei*, sp. n. The genus *Boophilus* is represented only by *B. calcaratus* Birula. The geographical distribution and hosts of each species are given —G. Verestchagin and I. Sidorytchev. Winter chemical regime of the rivers Selenga and Uda. The oxygen content of the water decreases sharply from the end of November and reaches its minimum early in February; parallel to that process, the carbon dioxide content increases. This must be of great importance to fish life.

(*Comptes rendus*, No. 3) —V. A. Silberminz: The deposits of cerite, bastnæsite, and a new mineral, lessingite, in the Kyshtym district, Urals. The deposits are described, and descriptions and chemical

analyses of the three minerals are given —**A. Mordvilko**: The anolocyclic plant-lice of *Pistacia* and the distribution of pistachios during the Tertiary period. The genus *Pistacia* was very widely distributed in the Tertiary, extending northwards as far as Greenland, where the plant-lice *Triphidaphis phaseoli*, representing a migrant form from pistachios, survive until the present time While *Pistacia* disappeared in such high latitudes under the influence of cold climate, it is impossible to account in the same way for the disappearance of *Pistacia* in some Mediterranean countries where in places only root-forms of pistachio aphids are to be found at present.—**A. Frank-Kamenetskii**· The fat of *Phoca sibirica* Gmel. Physical and chemical properties of the fat are described fully.—**D. D. Ivanenko**· A geometrical generalisation which may be useful in the quantum mechanics.

(*Comptes rendus*, No. 4.)—**P. Lazarev** The causes of plasticity of substances. The greater plasticity of loam as compared with sand is due to the ability of particles of loam to bind water on their surfaces. Capillarity must also play some part in the plasticity. —**L. A. Kulik**· The Mamra meteorite. A description of a meteorite which fell at Mamra in Kazakstan (Kirghiz Steppes) at night on May 5, 1927. The meteorite belongs to the stony meteorites and, probably, to sulphurous chondrites —**V. I. Romanovskii** The law of probability of frequencies subject to linear conditions and Pearson's criterium χ^2.—**A. A. Birula**: The pelvic bone of *Rhytina stelleri* Oser. Amongst the semi-fossil remains of *Rhytina stelleri* found at the Komandor islands, pelvic bones are rare; a detailed description of one such bone is given and illustrated. —**A. A. Birula**: A preliminary communication on the mammals of the kitchen midden of a Stone Age habitation on the Verkholensk mountain near Irkutsk. Remains of twelve species of mammals have been identified.—**N. Smirnov**: Diagnoses of some geographical varieties of *Phoca hispida* Schreb. Two new subspecies and one new form are described — **E. G. Shramkov**: The stability of the permanent magnetism of some rocks.—**B. V. Numerov**: The relation between the local anomalies of gravity and the derivatives of the potential.

PRAGUE.

Czech (Bohemian) Academy of Arts and Sciences (second class, Natural Sciences and Medicine), Mar. 8 —**J Petrbok**. Stratigraphy of the Pleistocene and Holocene in the plain of Arsuf in Palestine.—**Fr. Čechura**: Geomagnetic examination of the contact of Algonkian and granite near Příbram.—**J. Sekanina**· The symmetry of tourmaline —**J. Hýbl**: The dependence of saturated vapour-pressure on temperature. The author tested various formulæ with the vapour pressure data of liquid carbon dioxide, sulphur dioxide, ammonia, water, and hydrocarbons, the best record is given by a shortened formula of Kamerlingh Onnes: $\log p = a - \frac{b}{T} - cT + dT^2$.—**Jar. Hahn**. *Monocystis Mrázeki* —**J. Křepelka** and **F. Toul**: The dissolution of silver in water. Silver passes as Ag^+ into water containing atmospheric gases, being oxidised. The amount, determined by nephelometry, potentiometry, and conductance, varies between 0 01 mgm. and 0·037 mgm. Ag^+ per litre.—**K. Petr**: The composition of n-ary quadratic forms.—**E. Votoček** and **F. Rác**: The identity of E. Fischer's quinovose with d-glucomethylose (isorhodeose). Reduction of quinodose with sodium amalgam and identification of the methylpentite obtained with isorhodeite leads the authors to the same conclusion as Freudenberg and Raschig on the isolation of crystalline quinovose.

ROME.

Royal National Academy of the Lincei, Mar. 17.—**P. Vinassa de Regny**: The law of simple parametral relations and the distances of the components of the solar system. It has been recently shown that Hauy's law concerning simple and rational parametral relations holds not only for crystal lattices, but also for the distances of the electrons from the atomic nucleus. A similar relationship is now shown to exist in the cases of the sun's planets and of the satellites of Mars, Jupiter, Saturn, and Uranus.—**E. Soler**: The second gravimetric campaign on the Carso. Measurements made in 1926 at S. Canziano give for the gravitational constant the observed values, 980·568 cm. outside and 980 604 inside the cave, these becoming 980·698 and 980 696 respectively when corrected for the reduction in free air, and 980·661 and 980·684 when Bouguer's and topographical corrections are applied. The discrepancy between these values is considerably greater than the mean errors and is to be discussed later. The normal gravity value, derived from Helmert's formula (1901), is 980·676 cm.—**U. Pierantoni**. The symbiotic organ of *Silvanus surinamensis* (L.).—**G. Bemporad**: Photographic position of planet (1036).—**T. Boggio**: Hypersurfaces of spaces of constant curvature.—**V. Glivenko**: Certain general forms of the law of large numbers.—**A Kolmogoroff**· The law of large numbers —**Maria Pastori**· Total and partial commutation relative to derived tensors —**G. Scorza-Dragoni** The continuous dependence of the integrals of the equation $y' = f(x, y)$ on the initial values —**Pia Nalli**: The principal value of an integral.—**S. Finikoff** The congruences of Demoulin —**M. Manarini**· The motion of two variable masses which attract one another according to Newton's law. Vranceanu's equations (1928) have indicated the difficulty of this problem, but the introduction of a simple and plausible hypothesis regarding the variation of the masses furnishes a means of simplifying the investigation and of obtaining results comparable with those of Armellini (1915) and of Pizzetti (1915) —**A. Clementi**: investigations on arginase (7). Ureotelic character of the nitrogen metabolism of Chelonia. The urine of *Testudo Græca* and *Emys Europæa*, like that of *Bufo*, contains uric acid in very small proportions only, which are usually too minute to be determined. In the summer season the content of urea in the urine of these two organisms corresponds approximately with that in the urine of *Bufo* at the same period, namely, about 0·5 part per 1000. Oral administration of ammonia to *Testudo* and *Emys* causes a very marked increase in the urea content *prodie* and per 1000 of the urine, this being contrary to what is observed with uricotelic animals (birds). Hence, the nitrogen metabolism of the Chelonia is not, as with other reptiles and with birds, uricotelic, but ureotelic. —**V. Rivera**: Experimental cicatrisation of the stem of *Ricinus communis*, determined by *Pseudomonas fluorescens* (Flugge) Migula. Cuts made aseptically in the stem of *Ricinus*, and afterwards inoculated with a pure culture of *Pseudomonas fluorescens*, gradually seal up as a result of pronounced cellular proliferation at the sides of the cut, whereas control cuts, uninoculated, undergo no such sealing It may, therefore, be assumed that this organism, which is of universal occurrence, is the cause of the cicatrisation often observed after a root or a stem has been wounded.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 15, No. 2, Feb. 15) —**Arthur M. Banta** and **L. A. Brown**: Control of sex in Cladocera (3) Localisation of the critical period for control of sex. Females of *Moina macrocopa*

produce parthenogenetic eggs or, under adverse conditions, sexual eggs. Crowding of the females leads to production of eggs giving males; the critical time for crowding is about four hours (at 20° C.) before oviposition, which is more than three hours before spindle formation in the nuclei.—**Chas. W. Metz and Silka S. Ullian**: Genetic identification of the sex chromosomes in *Sciara* (Diptera). The males alone of these dipterans have two peculiar 'sex-limited' chromosomes, but these chromosomes are transmitted by all sperms. Sex chromosomes distinct from these have been detected by tracing the inheritance of a sex-linked character, swollen wing veins.—**Gregory Pincus**: A spontaneous mutation in the house mouse.—**G. A. Miller**: Possible α-automorphisms of non-Abelian groups.—**W. L. Ayres**: (1) On continuous curves having certain properties.—(2) On simple closed curves and open curves.—**I. A. Barnett**: On a relation between conformal and projective groups in function space.—**Francis D. Murnaghan**: On elements of content in metrical geometry.—**G. C. Evans and E. R. C. Miles**: Potentials of general masses in single and double layers. The relative boundary value problems.—**H. S. Vandiver**: Summary of results and proofs on Fermat's last theorem (4).—**Francis B. Sumner**: The analysis of a concrete case of intergradation between two subspecies. A mouse, *Peromyscus polionotus*, common in Florida and Alabama, has two races distinct in several characters, one existing on the coastal region and the other inland. The races are interfertile, but trapping them at a line of stations running inland shows an abrupt transition from one to the other. The coastal form seems to have arisen from the inland or a similar ancestral race, in adaptation to life on a background of pale sand.—**Edwin B. Wilson and Margaret M. Hilferty**: Note on C. S. Pierce's experimental discussion of the law of errors. The mean and standard deviation for many observations of an identical experiment repeated on 24 days vary much more than is predicted by the law of errors.—**Edwin H. Hall**: Photoelectric emission and thermionic emission once more. A theoretical criticism of experiments suggesting that photoelectric and thermionic work functions are equal.—**Gilbert N. Lewis and Joseph E. Mayer**: The quantum laws and the uncertainty principle of Heisenberg. In earlier papers, the second and third laws of thermodynamics were deduced from a single statistical principle implying that the properties of a system can be described by assuming a finite number Ω of possible states. Assuming that Ω is a minimum *sufficient* to account for the whole *behaviour* of a system, the fundamental laws of the quantum theory are developed.—**E. L. Nichols and H. L. Howes**: The transformation spectrum of the ruby. An incandescent ruby gives a continuous spectrum on which is superimposed a system of narrow emission bands. The latter appear in the temperature range corresponding to changes in the absorption of light by the ruby and occur in sets, including also the absorption and fluorescence bands of the ruby, with a constant frequency interval.—**Leonard B. Loeb and Karl Dyk**: The effects of a homologous series of amines on the mobilities of ions in hydrogen gas. With *N*-propylamine, there is a large initial drop in mobility of both positive and negative ions. With methylamine the negative ion mobility is decreased but the positive ion mobility is unaffected. Although the results are consistent with the formation of addition products with only one or two molecules, this explanation is not accepted.—**Marius R. Campbell**: Late geologic deformation of the Appalachian Piedmont as determined by river gravels. The rocks of this region are old, but minor flexures of more recent date have been discovered by tracing high level gravels in the area. Sections and a map are given.

Official Publications Received.

BRITISH

Proceedings of the Royal Society of Edinburgh, Session 1928–1929. Vol 49, Part 2, No 15 The Stability of Suspensions, III The Velocities of Sedimentation and of Cataphoresis of Suspensions in a Viscous Fluid By William Ogilvy Kermack, Anderson Gray M'Kendrick and Eric Ponder Pp 170-197 2*s* 6*d* Vol 49, Part 3, No 16 The Lyotrope Series and the Antagonistic Action of Ions By Dr W W Taylor Pp 198-209 1*s* Vol 49, Part 3, No 17 On the Asymptotic Expansion of the Characteristic Numbers of the Mathieu Equation By Sydney Goldstein Pp 210 223 1*s* Vol 49, Part 3, No 18 Quanta in Biology By Hans Przibram Pp 224-231 9*d* Vol 49, Part 3, No 19 Colour Sensitivity. By G N Hunter Pp 232 244 1*s* Vol 49, Part 3, No 20 Bands in Hydrogen related to the Fulcher System By Dr Ian Sandeman Pp 245-255 1*s* (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd)

Harper Adams Agricultural College, Newport, Salop Advisory Report No 4 Report of the Advisory Department, 1928–1929 Pp ii+24 (Newport, Salop)

Transactions of the Yorkshire Numismatic Society Vol 3, Part 2 Edited by T Sheppard Pp 57-80 (Hull) 5*s*

The Ross Institute and Hospital for Tropical Diseases (Incorporated), Putney Heath, London, S W 15 Annual Report and Accounts for 1928 Pp 59 (London)

The Proceedings of the Physical Society Vol 41, Part 4, No 229, June 15 Pp iv+231-430 (London) 7*s* net

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 67, No 390, June Pp 685-812+xxxviii (London: E and F N Spon, Ltd) 10*s* 6*d*

Memoirs of the Cotton Research Station, Trinidad Series A Genetics. No 1 Studies on the Inheritance of (a) Petal Spot, (b) Pollen Colour, and (c) Corolla Colour in the Cotton Plant By S C Harland Pp 53+3 plates (London Empire Cotton Growing Corporation) 2*s* 6*d*

The Himalayan Journal Records of the Himalayan Club Edited by Kenneth Mason Vol 1, No 1 Pp 150 (Calcutta Thacker, Spink and Co) 5 rupees, 8*s*

Joint Board of Research for Mental Diseases City and University of Birmingham Annual Report of the Laboratory for the Year ending March 14th, 1929 Pp 17 (Birmingham)

Canada Department of Mines Mines Branch Industrial Fuel and Power Statistics for Ontario, Calendar Year 1928 By E S Malloch and C E Baltzer (No 698) Pp iv+23+12 plates (Ottawa F A Acland)

Department of Agriculture, Ceylon Bulletin No 84 Fodder Grass Trials on the Experiment Station, Peradeniya By T H Holland Pp 12+6 plates 40 cents Bulletin No 85 The Termite-proof Construction of Buildings in Ceylon By F P Jepson Pp iv+36+26 plates 40 cents (Peradeniya)

The Economic Proceedings of the Royal Dublin Society Vol 11, No. 25 The Production of Essential Oils from Irish grown Plants Part 5 Note on Oil of Dill By J Reilly, P J Drumm and C Boyle Pp 415-418 (Dublin Hodges, Figgis and Co , London Williams and Norgate, Ltd) 6*d*

Survey of India. General Report, from 1st October 1927 to 30th September 1928 Pp v+86+4 plates (Calcutta) 1 rupee, 1*s* 9*d*

Records of the Geological Survey of India Vol 61, Part 4, March Pp 327-367+xxx+vii+plates 26-29 2 12 rupees, 5*s* Vol 62, Part 1, April Pp 185 2 12 rupees, 5*s* (Calcutta Government of India Central Publication Branch)

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1179 (Ae 343) The Airflow around a Circular Cylinder in the Region where the Boundary Layer separates from the Surface By A Fage (T 2644) Pp 18 9*d* net No 1194 (Ae 356) An Investigation of Fluid Flow in Two Dimensions By Dr A Thom (T 2680) Pp 18+10 plates 1*s* net No 1206 (Ae 367) Wind Tunnel Experiments with Infinite Cascades of Aerofoils By Dr R G Harris and R A Fairthorne. (T 2685) Pp 18+11 plates 1*s* net No 1210 (Ae 370): On the Effect of Air Compression on Drag and Pressure Distribution in Cylinders of Infinite Aspect Ratio By T E Stanton (T 2689) Pp 5+2 plates 6*d* net No 1218 (Ae 377) The Hydrodynamic Factors on a Cylinder moving in Two Dimensions By Prof H Lamb (T 2744) Pp 5 4*d* net (London H M Stationery Office)

University of Bristol The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1928 Pp 200+9 plates (Bristol)

The Cawthron Institute, Nelson, N Z Cawthron Lecture The Work for Agriculture of Two Great Englishmen By Sir John Russell Pp 12+6 plates (Cawthron, N.Z)

Department of Scientific and Industrial Research, Dominion of New Zealand Observations of Upper Air-Currents at Apia, Western Samoa (Second Series) By Andrew Thomson Pp 79 (Wellington, N Z : W A. G Skinner)

The University of Leeds Department of Coal Gas and Fuel Industries (with Metallurgy) Report of the Livesey Professor for the Sessions 1926–27 and 1927–28 Pp 15 (Leeds)

Proceedings of the Society for Psychical Research Part 111, Vol 38, June Pp 411-516 (London Francis Edwards, Ltd) 4*s*

Empire Cotton Growing Corporation Report of the Eighth General Meeting Pp 16 (London)

The Newcomen Society for the Study of the History of Engineering and Technology Transactions, Vol 7, 1926–1927 Pp xi+159+21 (London) 20*s*

FOREIGN

Svenska Linné-Sallskapets Arsskrift Årgång 12, 1929 Pp v+194. (Uppsala Almquist and Wiksells Boktryckeri A -B)

Proceedings of the Imperial Academy Vol 5, No 4, April Pp. vii+161-181 (Tokyo)

Prirodovědecke prace J E Purkyně v zrcadle kritiky jiných badatelů Ce qui a ete ecrit sur les travaux scientifiques de Jan Evangelista Purkyně (Purkinje) par les biologistes Napsal O V Hykeš Pp 51 (Praha Knihtiskarma Jednoty československych matematiků a fysiků)

Spisy vydavani Přírodovědeckou Fakultou Masarykovy University Čis 103 Příspěvek ke studiu komplexních solí dimethylglyoximu (Contribution à l'etude de combinaisons complexes de la dimethylglyoxime) Napsali J. V. Dubský a Fr Brychta Pp. 28 Čis 104 Sur une classe de surfaces Par Jos Kaucky Pp 21 Čis 105 Iter Turcico-Persicum Pars 4 Plantarum collectarum enumeratio (Plumbagineae—Cyperaceae) Scripsit Dr Fr Nabělek Pp 48+4 tab Čis 106 Sur une classe de surfaces minima plongees dans un espace à cinq dimensions à courbure constante Par Otakar Borůvka Pp 28 Čis 107 Sur les surfaces du troisieme degré qui ont, aux points d'une courbe plane, un contact d'ordre deux avec une surface generale Par Ladislav Seifert Pp 17 Čis 108 Nový typ thermostatu (A new Type of Thermostat) Napsal Vaclav Cupr Pp 8 (Brno A Píša)

Proceedings of the California Academy of Sciences, Fourth Series Vol 17, Nos 11 and 12 Report of the President of the Academy for the Year 1928, by C E Grunsky, Report of the Director of the Museum for the Year 1928, by Barton Warren Evermann Pp 297-360 (San Francisco)

Bergens Museums Årbok, 1929 Hefte 1 Naturvidenskapelig rekke Nr 1 Draktskiftet hos lirypen (*Lagopus lagopus* Lin) i Norge, av Sigurd Johnsen, Nr 2 Rovdyr- og rovfuglstatistikken i Norge, av Sigurd Johnsen Pp 84+140+17 plancher (Bergen A-S John Griegs Boktrykkeri)

Proceedings of the United States National Museum Vol 75, Art 15 A new Crab from the Eocene of Florida By Mary J Rathbun (No 2786.) Pp 4+3 plates (Washington, D C Government Printing Office)

Gorgas Memorial Laboratory Hearings before the Committee on Foreign Affairs, House of Representatives, Seventieth Congress, First Session on H R 8128 To authorize a Permanent Annual Appropriation for the Maintenance and Operation of the Gorgas Memorial Laboratory, January 20, 1928 Statements of Hon Maurice H Thatcher, Dr Franklin Martin, Edgar Wallace, Dr Bowman C Crowell, Dr George W Crile, Henry S Wellcome, Surg-Gen Merritte W Ireland, Surg-Gen Hugh S Cumming, Dr Arthur T McCormack, Dr Herman N Bundesen Pp iv+90. (Washington, D C Government Printing Office)

Memoirs of the College of Science, Kyoto Imperial University Series B, Vol 4, No 3, Articles 7 17. Pp. 165-369+plates 26-30 (Kyoto and Tokyo Maruzen Co, Ltd)

Carnegie Institution of Washington Year Book No 27, July 1, 1927, to June 30, 1928, with Administrative Reports through December 14, 1928 Pp xix+438+2 plates (Washington, D C Carnegie Institution)

Studies in Comparative Seismology Earthquake Conditions in Chile By Bailey Willis With Contributions by J B Macelwane, Perry Byerly, Johannes Felsch and H S Washington (Publication No 382) Pp xi+178+75 plates (Washington, D C Carnegie Institution) 5 50 dollars

Miocene Mollusks from Bowden, Jamaica Part 2 Gastropods and Discussion of Results By Wendell P Woodring (Contributions to the Geology and Palaeontology of the West Indies) (Publication No 385) Pp vii+564 (40 plates) (Washington, D C Carnegie Institution) 7 dollars

The Genus *Haplopappus* a Phylogenetic Study in the Compositae By Harvey M Hall (Publication No 389) Pp viii+391 (16 plates) (Washington, D C Carnegie Institution) 5 dollars

The Hydrostatic-Pneumatic System of certain Trees Movements of Liquids and Gases By D T MacDougal, J B Overton and Gilbert M Smith (Publication No 397) Pp 99 (Washington, D C Carnegie Institution) 1 25 dollars

Contributions to Palaeontology from Carnegie Institution of Washington Papers concerning the Palaeontology of the Cretaceous and Later Tertiary of Oregon, of the Pliocene of Northwestern Nevada, and of the Late Miocene and Pleistocene of California By Charles W Gilmore, John H Maxson, John C Merriam and Chester Stock (Publication No 393) Pp v+58+13 plates (Washington, D C Carnegie Institution) 1 50 dollars

Papers from the Tortugas Laboratory of Carnegie Institution of Washington Vol 26 An Investigation on Organization in a Sea-Urchin Egg, by David H Tennent, C V Taylor and D M Whitaker, Activation of the Eggs of *Echinometra mathaei* by Sperms of the Crinoids *Comatula pectinata* and *Comatula purpurea*, by David H Tennent, Early Development and Larval Forms of three Echinoids of the Torres Strait Region, by David H Tennent, On the Postlarval Development of the Coral *Maeandra areolata* (L), by H Boschma, On the Morphology, Coloration and Behavior of seventy Teleostean Fishes of Tortugas, Florida, by E W Gudger, Observations on certain Littoral and Terrestrial Animals at Tortugas, Florida, with Special Reference to Migrations from Marine to Terrestrial Habitats, by A. S. Pearse, Two new Mites from the Gills of Land Crabs, by A S Pearse, Further Studies on Marine Bacteria with Special Reference to the Drew Hypothesis on $CaCO_3$ Precipitation in the Sea, by C B Lipman, The Chemical Composition of Sea-Water, by C B Lipman Pp iii+257+4 plates (Washington, D C Carnegie Institution) 2 50 dollars

Japanese Journal of Astronomy and Geophysics Transactions and Abstracts Vol 6, No 3 Pp iii+143-178+39-64 (Tokyo National Research Council of Japan)

Scientific Papers of the Institute of Physical and Chemical Research No. 189 A Study on the Helium Band Spectrum, 2 By Sunao Imanishi Pp 237 252+plates 23-25 (Tokyo Iwanami Shoten) 35 sen

CATALOGUES

The Far East its History, Literature and Arts, Books and Views relating to Japan, China, Korea, Formosa, Siam, the Philippine Islands and the Far East Indian Archipelago. (Catalogue 516) Pp 48 (London Francis Edwards, Ltd)

Early American Voyages and other Travels (Catalogue No 26) Pp. 48. (Newcastle-upon-Tyne William H Robinson)

Diary of Societies.

FRIDAY, JUNE 28

PHYSICAL SOCIETY (at Imperial College of Science), at 4 45 —Dr Teresa J Dillon The Relation between Hydrogen Pressure and Filament Resistance in a Tube containing Glowing Tungsten —Dr Frances Lowater The Band Systems of Titanium Oxide —F E Smith The Absolute Measurement of Sound Intensity —A Demonstration of an Apparatus for the Measurement of Electrical Resistance at High Temperatures will be given by Dr J L Haughton

MONDAY, JULY 1

ROYAL SOCIETY OF EDINBURGH, at 4 30 —Gunning-Victoria and Makdougall-Brisbane Prizes to be presented —Prof R A Sampson and Prof A E Conrady Description of Three Huygens Lenses in the Possession of the Royal Society of London —W J M'Callien The Metamorphic Rocks of Kintyre —Dr T M Finlay Old Red Sandstone of Shetland (North-Western Area)

ROYAL INSTITUTION, at 5 —General Meeting

TUESDAY, JULY 2

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (jointly with Institution of Engineers and Shipbuilders in Scotland) (at Newcastle-upon-Tyne), at 10 A M —Sir Westcott S Abell The Story of Safety at Sea —J Ireland The Applications of Monel Metal in Engineering and Shipbuilding

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham), at 11 A M

ROYAL SOCIETY OF MEDICINE, at 4 30 —Annual General Meeting

BRITISH WATERWORKS ASSOCIATION (at Portsmouth) (continued on July 3, 4, and 5)

WEDNESDAY, JULY 3

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (jointly with Institution of Engineers and Shipbuilders in Scotland) (at Newcastle-upon-Tyne), at 10 A M —J L Adam Some Notes on Damage to Ships —R P Sloan Developments in the Uses of Electricity

FRIDAY, JULY 5

INSTITUTION OF CIVIL ENGINEERS (Birmingham and District Association), at 8 30 A M —Visit to Liverpool to see the Work in connexion with the Mersey Tunnel

OVERHEAD LINES ASSOCIATION, at 12 15 P M —Visit to the Mid-Cheshire Electricity Supply Company

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College, Gower Street), at 7 30 —Christopher T A Gaster Chalk Zones in the Neighbourhood of Shoreham, Brighton, and Newhaven, Sussex —H G Smith Some Features of Lamprophyres, near Sedbergh, Yorkshire

SATURDAY, JULY 6

PHYSIOLOGICAL SOCIETY (at Oxford)

TUESDAY, JULY 9

SOCIETY OF CHEMICAL INDUSTRY (at Manchester), at 10 15 A M.—Annual General Meeting —Dr A D Little Science and Labour

WEDNESDAY, JULY 10

SOCIETY OF CHEMICAL INDUSTRY (at Manchester), at 10 A M —Annual Meeting —Prof T H Pear The Human Factor in Industry —Dr A. D. Little Process Development

INSTITUTION OF MINING ENGINEERS (at University College, Nottingham), at 11 A M —General Meeting —Dr W Hancock, A G R Whitehouse, and Dr J S Haldane The Salts lost by Sweating owing to High Air-temperatures (Sixteenth Report to the Committee on The Control of Atmospheric Conditions in Hot and Deep Mines) —Dr J S Haldane Work of the Committee of the Institution of Mining Engineers on The Control of Atmospheric Conditions in Hot and Deep Mines —The following papers will be submitted for further discussion —W S Cooke and I C F Statham The Flow of Air at Bends and in Straight Airways (Sixth Report of the Midland Institute Committee on the Ventilation of Mines) —Dr T David Jones Spontaneous Combustion in North Staffordshire Part II A Record of Analyses of Air-samples taken during the Combating of a Fire —Dr T F Wall Electro-magnetic Testing of Wire Ropes —2 15 —The General Meeting will be resumed —3 30 —The General Meeting will be closed

CONFERENCE.

JULY 1 TO 5

MUSEUMS ASSOCIATION (at Worthing)

Monday, July 1

Tuesday, July 2, at 10 A M (in Connaught Hall) —Sir Henry A Miers Co-operation—the Association's Task (Presidential Address) —Reading and Discussion of Papers

At 3 (in Connaught Hall) —Reading and Discussion of Papers

Wednesday, July 3, at 10 A M (in Connaught Hall) —Reading and Discussion of Papers bearing on the Co-operation of Museums in this Country and throughout the Empire, and on the Work of the Association in this Connexion

At 2 15 (in Connaught Hall) —Reading and Discussion of Papers

Thursday, July 4, at 10 A M —Reading and Discussion of Papers

At 11 30 A M —Annual Business Meeting

Friday, July 5 —Excursions